Estimation of Passive Use Values Associated with Future Expansion of Provincial Parks and Protected Areas in Southern Ontario

by

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Abstract

This thesis conducts a valuation of environmental benefits and an assessment of the social returns of investing public funds in protected areas in the Mixedwood Plains of southern Ontario. Costs and benefits were estimated for expanding protected areas in ecodistrict 6E-12, a region within the Mixedwood Plains. Benefits were represented by passive-use values employing survey-based methods of stated preferences. Costs were estimated with a hedonic model of land characteristics used to predict acquisition costs of land purchases necessary to expand the protected area network in 6E-12. Robust results indicate the public of Ontario is willing to pay to expand the protected area network. Cost and benefit curves for 6E-12 provide numerous policy recommendations for the future of protected areas including the optimal level of coverage that could maximize public welfare in Ontario and the cut-off point where the benefits of protected areas are equal to their costs of acquisition.

Acknowledgements

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1 Introduction

Biodiversity is threatened all over the world and the latest projections predict that 25% of all animal and plant species could be driven to extinction in the first few decades of the 21st century (Millennium Ecosystem Assessment 2005). Increased destruction of natural habitat, urbanization, industrialization, introduction of invasive species, pollution, over-harvesting, disruption of the food chain and natural ecological processes are accelerating the rate of extinction (Millennium Ecosystem Assessment 2005). Southern Ontario contains the Mixedwood Plains, a diverse ecoregion of natural habitat which is home to the highest concentration of plant and animal biodiversity in Canada. The area is also characterized by high economic prosperity, agricultural activity, road and human population density placing increased pressure on the natural environment (Ontario Ministry of Natural Resources 2005).

Due to this high degree of agricultural activity, urbanization and industrialization, approximately 40% of all Canadian species at risk occur in Ontario and the majority of these species are present in the Mixedwood Plains. While 10.7% of northern Ontario is protected, only 0.6% of the Mixedwood Plains are now protected land and most of the reserves are too small or poorly interconnected to support healthy ecosystems (Ontario Ministry of Natural Resources 2005). The current protected area coverage is therefore much lower than the minimum of 12% advocated in the UN Brundtland Report on sustainable economic development (World Commission on Environment and Development 1987).

To address these issues the Ontario Ministry of Natural Resources initiated the Ontario Biodiversity Strategy in collaboration with major public and private stakeholders in Ontario. The objective of the strategy is to promote sustainable development in Ontario in order to safeguard environmental resources for future generations. Strategy objectives include: encouraging commitment amongst Ontarians towards sustainable development; promoting responsible land practices amongst land owners that promote sustainable development; and ensuring that important natural habitat is preserved for future generations (Ontario Ministry of Natural Resources 2005).

Ontario Parks (OP) is a branch within the Ontario Ministry of Natural Resources which manages the provincial parks network in the province and ensures they protect significant natural habitat, cultural and recreational environments. To this end, OP in partnership with private non-profit conservation organizations invests public funds for acquiring additional land for conservation purposes (Ontario Parks 2007). The following research project was commissioned by OP to estimate the costs and benefits associated with expanding the protected area network of southern Ontario in order to approach the optimal allocation of protected areas within the Mixedwood Plains.

Cost benefit analysis (CBA) has been proposed as the means to evaluate public investment projects such as environmental conservation. CBA monetizes and weighs the stream of costs and benefits of the investment and helps prioritize public projects based on whether they are providing positive or negative returns to society. Normally a full CBA requires the evaluation of all relevant primary and secondary benefits and costs to generate sufficient insights for public decision making. Due to budget, logistics, time restrictions and the fact that OP had already commissioned a study eliciting the *use values* associated with some specific protected areas in southern Ontario (Shantz et al. 2002), the scope of the analysis was limited to passive use values the public of Ontario places on protected areas in the Mixedwood Plains as a whole. In addition the costs and benefits for acquiring additional land for conservation purposes were estimated for ecodistrict 6E-12, a small region within the Mixedwood Plains.

Environmental resources such as pristine natural habitat and healthy ecosystems are not actively traded in the marketplace and as a result have no clearly defined market value. Hypothetical methods that simulate market transactions, such as contingent valuation and choice experiments, have been proposed as a solution to estimate the public willingness to pay (WTP) for environmental resources. Such elicitation techniques require public participation through the administration of a survey instrument and the use of public focus groups and pre-tests to guide the survey design. Furthermore, the hypothetical nature of the valuation process calls for the application of several techniques to address hypothetical bias in order to produce reliable and conservative passive use value estimates (Carson and Hanemann 2005).

The discrete choice question format when combined with a tax-based payment vehicle, has been recognized in the literature as being incentive compatible for respondents to provide their true WTP in hypothetical scenarios (Freeman III 2003). The question format adopts a take-it-or-leave it approach where the respondent is asked whether he or she is willing to pay a specified amount for a proposed program that expands protected areas in the Mixedwood Plains versus not paying which is equivalent to remaining in the status quo. The data from this pair wise comparison can then be analysed with a logit model using a utility difference model consistent with the theory of random utility. Once the public WTP has been estimated it is possible to calculate a benefits curve for different levels of protected area coverage in the Mixedwood Plains.

Data for the survey were obtained using an Ontario province-wide internet panel maintained by the North American wide research firm Ipsos Reid, to be demographically representative of the public of Ontario. Each of the 1,629 respondents answered 8 discrete choice valuation questions resulting in a total of 13,032 observations. In addition to the 8 valuation questions the survey gathered socio-demographic characteristics and questions designed to elicit respondent's attitudes towards the environment in order to gain further insights into voting behaviour. The time frame of the protected area expansion was also included as an attribute in the valuation scenarios to elicit public preferences for an expansion to take place in the short term or the long term.

A hedonic price model developed by Richard Vyn (2007) formed the basis of the cost estimation using data provided by the Municipal Property Assessment Corporation (MPAC). The model used land characteristics and

1,935 actual market transactions 2002-2006 of agricultural land in the Mixedwood Plains to predict the contribution of specific land attributes to final market value. Experts from Ontario Parks used internal procedures to select 28 parcels of representative habitat in need of conservation within ecodistrict 6E-12, a small region within the Mixedwood Plains. The parameters from Vyn's hedonic model were used to estimate the acquisition price of each parcel after which they were sequenced in order of price/acre. This procedure produced a smooth non-linear cost curve showing the minimum cost required to achieve a certain level of protected area coverage.

Cost and benefit curves in ecodistrict 6E-12 were able to identify numerous policy relevant results including the level of coverage that optimizes social welfare and the cut-off point where costs are equal to benefits and any further expansion of the protected area network would only serve to decrease social welfare. The stream of costs and benefits were generated over many years requiring discounting with an appropriate discount factor and accounting for estimated changes in land prices over time. For these reasons a sensitivity analysis was performed to elicit the effects of different cost estimates and discount periods on final results.

This thesis will present the methodology adopted for the cost and benefit analysis; estimation of the WTP for protected areas in the Mixedwood Plains; and a joint analysis of the costs and benefits for ecodistrict 6E-12. Chapter 2 explains the methodology for estimating the costs and benefits and the major steps in the survey design; chapter 3 describes the data used for the CBA and the representativeness of the survey sample for the public of Ontario, and provides an analysis of major results including an outline of Ontarian willingness to pay for protected areas and a joint estimation of the costs and benefits of expanding the protected area network in ecodistrict 6E-12. Finally chapter 4 will conclude with a summary of major results, policy recommendations for the future of the protected area network of southern Ontario and a discussion of the limitations of the study and areas for future research. The appendices provide additional analysis of voting behaviour, tables and figures of major calculations and selected statistical tests, the methodology used to determine the initial bid levels; discussion of voting behaviour based on environmental sentiments and the use of the New Environmental Paradigm Scale (NEP); and a copy of the survey used for the WTP estimation.

The objectives of this research project is to provide practical policy guidelines that help decision makers to identify the appropriate level of protected area coverage that maximizes social welfare within the Mixedwood Plains, and identify areas of future research that can reinforce public decision making for the allocation of protected areas in southern Ontario.

2 Methods

This chapter provides an overview of general cost-benefit analysis (CBA), the methodology used to measure costs and benefits associated with a protected area expansion in southern Ontario as well as an outline of the major steps in the survey design.

2.1 Cost-Benefit Analysis

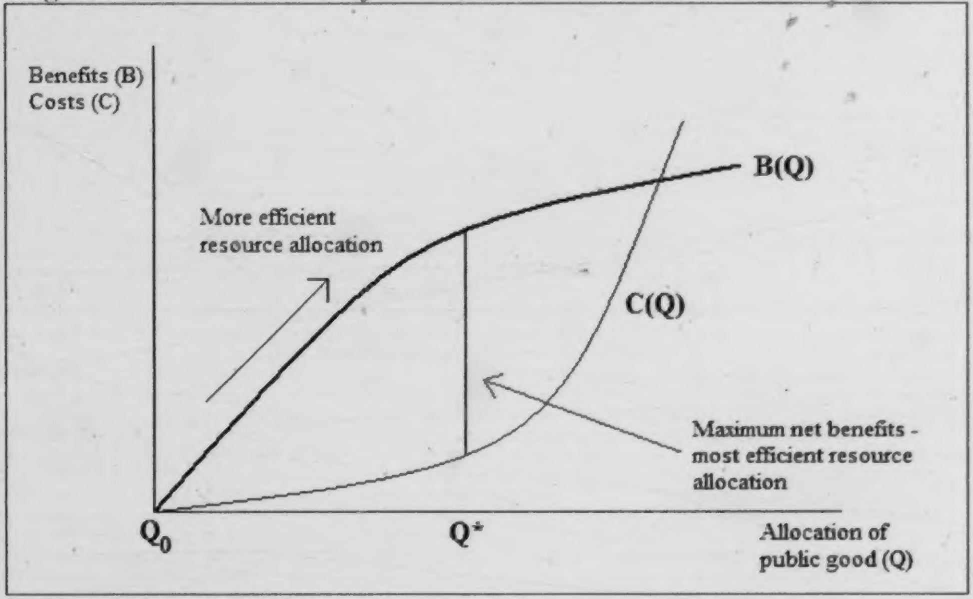
Cost-benefit analysis (CBA) is frequently used as a framework to guide public decision making by weighing the monetary costs and benefits of public investment projects. CBA facilitates decision making by estimating the monetary value of the positive and negative effects associated with a public project and measuring its net present value (NPV). This allows decision makers to better address the economic implications the project might have and compare changes in social welfare between different policies (Arrow et al. 1996).

When costs and benefits are spread over time the stream of costs and benefits must be discounted with an appropriate discount rate to estimate their net present value (NPV). Negative NPV gives an indication that the public investment is reducing social welfare while a positive NPV gives an impression the public investment could be increasing welfare in society as a whole (Boardman et al. 2006). However, a project with a positive NPV requires further analysis of how the benefits are distributed by identifying the beneficiaries and the disadvantaged within the society. CBA is therefore no final seal of approval for public investment projects (Stavins 1984).

Net social benefits (NSB) can be measured as the sum of consumer surplus and producer surplus which is equivalent to estimating the present value of benefits, PV(B), minus the present value of costs, PV(C), associated with a public project. It can be shown that the NPV is equal to the present value of NSB. This means that when a project with the highest NPV is selected that same project has the highest present value of net social benefits (Boardman et al. 2006). Figure 2-1 shows the present value of benefit, B(Q), and the present value of costs, C(Q), as functions of the quantity allocated for the public good

(Q). In the case of the current CBA, Q would be the level of coverage for protected areas in the Mixedwood Plain, B(Q) would be the public WTP for each level of protected areas, while C(Q) would be the acquisition costs of acquiring a certain level of protected area coverage in the Mixedwood Plains. The figure shows that the two curves can define the optimal allocation of Q where NSB are maximized. Moving towards Q* from the left increases efficiency while further allocation of Q beyond Q* serves to decrease efficiency. This would mean that allocating Q* for the level of coverage for protected areas would generate the highest NPV compared to other allocations of Q[1] (Boardman et al. 2006).

Figure 2-1. CBA can identify the most efficient resource allocation



Source: Boardman et al. (2006)

Non-market values associated with natural resources are frequently divided by resource economists into *use values* which are connected to direct use of the resource (often related to recreational activities such as camping, hunting, hiking, etc.) and *passive use values* which do not require present or future use by individuals to be perceived as valuable to them (Bateman and Willis 1999). Ontario Parks had already commissioned a study eliciting the *use values* associated with protected areas in southern Ontario (Shantz et al. 2002) and therefore passive use values associated with the same region of interest became the focus of this study. Protected areas in southern Ontario are not actively traded in the marketplace and therefore have no clearly defined market prices. Non-market estimation techniques must therefore be utilized to measure their potential benefit to the public (Freeman III 2003).

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[1] E.g. $NPV(Q^*)>NPV(Q_3)>NPV(Q_1)$.

In principle a full scale CBA would include all the positive and negative effects a project would entail but unfortunately the overall scale of the analysis must often be restricted by budget and time constraints. This CBA will therefore be limited to the benefits generated by passive use values associated with the existence of protected areas in southern Ontario while the costs focus on the expenditures required for expanding the protected area network. Chapters 2.2 and 2.3 explain in further detail the methodology involved in estimating these benefits and costs.

2.2 Benefits

Stated preference techniques have been extensively used in the literature to estimate passive use values for public goods such as environmental improvements[2]. Stated preference techniques require a survey instrument which describes the current state of an environmental resource while introducing proposed programs that result in changes in its quality. In the case of the current CBA, the present coverage of protected areas in southern Ontario would represent the status quo while changes in its quality and quantity would be described by the increase in coverage that the proposed program would entail. Respondents are then asked to state their willingness to pay (WTP) an imposed cost on their household for the implementation of the proposed program (Carson and Hanemann 2005).

While most stated preference projects focus on the total value of the environmental improvement, we examine the value of various sizes of protected area expansions – facilitating the development of the marginal benefits of protected area investments. The analysis of various sizes of protected areas provides a validity test for the stated preference estimates and the marginal benefit function can then be compared to the marginal costs of protected area investment. Careful survey design is crucial to the final outcome of a passive use valuation study (Freeman III 2003). The following chapter provides a detailed overview of the survey design process, experimental design, focus group sessions and pre-tests.

---

[2] Public goods are commodoties provided by governments for public consumption. Typical examples of public goods include road networks, law enforcement, education, social services, museums and environmental preservation.

2.2.1 Valuation Tools

Resource and environmental economists divide the benefits derived from natural resources into *use values* which describe direct benefits from using the resources (e.g. nature recreation, logging, mining, clean breathable air and water, etc.) and indirect benefits measured as *passive use values*. Passive use values (also known as existence-, intrinsic- and non-use values) represent people´s willingness to pay (WTP) for the continued existence of natural resources regardless of their current or future use. Natural resources such as protected areas also bear the characteristics of public goods in the sense that one person´s passive use does not exclude the passive use of another individual or reduce the amount that can be "passively" consumed by others (Freeman III 2003). Ontario Parks had commissioned studies on the use-values of selected protected areas in Ontario (Shantz et al. 2002) and was interested in estimating the overall passive use values of the protected area network in southern Ontario. Stated preference methods are currently considered the valuation tool of choice by environmental economists for passive use valuation and have been frequently used for policy guiding purposes by governmental agencies around the world over the last 20 years (Carson and Hanemann 2005; EVRI 2007).

Measuring Passive Use Values

Passive use values of natural resources cannot be observed in the marketplace and stated preference methods must therefore create scenarios that simulate market transactions of environmental commodities. Numerous approaches have been developed over the years which can be roughly divided into open-ended contingent valuation, binary choice contingent valuation, attribute-based methods and paired comparison (Champ et al. 2003). The binary choice referendum format, paired with a coercive payment vehicle, is recommended for passive use evaluation by the blue ribbon NOAA[3] panel. Its take-it-or-leave-it approach is considered incentive compatible for respondents to reveal their true willingness to pay for public goods (Arrow et al. 1993; Carson and Hanemann 2005). The binary choice format has also been used extensively in the literature for passive use valuation and therefore provides numerous opportunities to compare model results and test statistics with those of previous studies (EVRI 2007). The binary choice experimental design required the development of attributes, attribute levels, choice sets and blocks which will now be examined in further detail.

Attributes and Levels

Each proposed program was described by a set of characteristics commonly referred to as attributes. The attributes in turn vary according to pre-determined levels or intensity to capture a minor, medium or major quality change in the environmental resource from the current situation. These attributes form descriptive variables that allow the estimation of respondent´s preferences for particular program characteristics. Three different attributes were chosen to describe the various proposed programs: Coverage, Time and Cost.

Table 2-1. Attributes and levels of proposed program characteristics

Attributes	Attribute Levels	Intensity
Coverage	1% - 5% - 12%	Minor – Medium – Major
Time	10 Years – 20 Years	Short term – Long term
Price	$20 - $60 - $175 - $325	Very low – Low – High – Very High

---

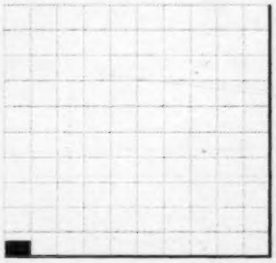
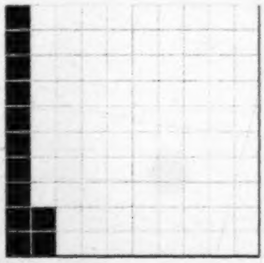
[3] In the early 90´s contingent valuation methods were surrounded by controversy and in response the National Oceanic and Atmospheric Administration commission a panel of independent and highly regarded economists to address the validity of non-market valuation techniques for passive use value assessment. The panel approved of passive use valuation using non-market techniques as long as they followed the panel´s stringent guidelines.

Table 2-1 provides an overview of the attributes and their corresponding levels while the text that follows gives a more detailed description of each attribute and how their levels were determined.

Coverage:

Three different levels of protection showing a minor, medium and major expansion (1%, 5% and 12%) were used as attributes representing the quality change a protected area expansion would have on the current situation in southern Ontario. These levels are commonly used as the basic coverage criteria by Ontario Parks when employing the C-Plan Conservation Planning System, a software package used to select natural habitat for protection based on predetermined conservation goals (Department of Environment and Conservation 2007). The highest level of 12% also represents the minimum protection of natural habitat recommended by the Brundtland Report to achieve sustainable economic development of natural resources (World Commission on Environment and Development 1987).

Figure 2-2. An example of the graphical representation of the level of protected area coverage in the Mixedwood Plains

Vote	Current Situation	Proposed Program
Protected area targets ■ **Protected land** ☐ **Normal land**	**0.6% (630 km^2)** of the Mixedwood Plains protected 	**12% (12,600 km^2 approx.)** of the Mixedwood Plains protected 

To help respondents grasp the meaning of increasing the ratio of protected areas in the Mixedwood Plains a graphical representation was used to supplement information on coverage. A grid of 100 hundred white squares corresponding to normal unprotected land was filled with green squares that represented protected areas which can be seen above in figure 2-2.

Time:

In order to detect public preferences for the time frame needed to achieve the protected area targets a time attribute representing the short term (10 Years) and the long term (20 Years) was included in the analysis.

Price:

The bid vector is designed to capture the shape of the WTP function by asking respondents whether they are willing to pay the specified cost for the proposed program. The WTP distribution represents the ratio of respondents voting yes for purchasing the public good at each bid level (Grafton et al. 2004). The cost estimates in table 2-2 were used as a guideline for the initial bid vector used in the pre-tests and focus groups. They are linear cost estimates per Ontario household using the average acquisition costs for new protected areas in the Mixedwood Plains over the last 10 years (1996-2006) in 2006 dollars and assuming no increases in land prices over time. Further details on the cost calculations can be found in the appendix.

Table 2-2. Cost estimates for achieving protected area targets in the Mixedwood Plains

Protected area target	Costs per Ontario household
1%	$26/household
5%	$131/household
12%	$315/household

As can be seen in table 2-2 the cost estimates for a 5% and 12% expansion might be considered unreasonably high for low income households. Therefore the calculations were repeated for a 5 year payment vehicle using a 5% discount factor which can be seen in table 2-3.

Table 2-3. Cost estimates for achieving protected area targets in the Mixedwood Plains: Using a 5 year tax payment vehicle discounted at a 5% interest rate

Protected area target	Costs per Ontario household
1%	\$5/household for 5 years
5%	\$27/household for 5 years
12%	\$65/household for 5 years

Expanding protected areas in the Mixedwood Plains requires the acquisition of millions of hectares of land and in order to credibly collect sufficient funds to expand protected areas in southern Ontario at "reasonable[4]" prices a five year tax payment vehicle was adopted. The two highest bid levels in tables 2-2 and 2-3 were used for the initial bid vector employed in the focus groups and the pilot tests: [\$25,\$60,\$130,\$250].

Bid values around or near the center of the WTP distribution are most important for obtaining accurate estimates of the median WTP. Bids placed in the outer 12% tails of the logistic distributions are less efficient in providing information on the shape of the WTP function and would require extremely large sample sizes in order to generate enough positive responses to be of use for the analysis. It is therefore important that bids are spread widely enough in order to capture the 50% median point as well as the upper and lower end of the distribution while providing enough variation for statistical analysis (Bateman and Willis 1999). Results from the pilot test in chapter 3.1 showed it was necessary to adjust the bid vector used in the pre-tests in order to capture the shape of the WTP distribution more efficiently.

Choice Sets

Each pair wise comparison or vote between the current situation and a proposed program represents a choice set or profile which is described by attributes and their corresponding levels. Figure 2-3 below gives an example of a choice set used in the questionnaire.

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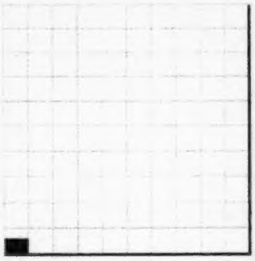
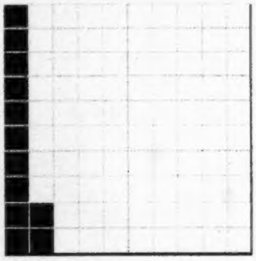
[4] Reasonable prices were arbitrarily determined (*ad* hoc) to be less than \$100/household per yer for 5 years. This assumption was later confirmed in the public focus groups where most people found the lower two bids more reasonable [\$25,\$60] than the highest two bids [\$130,\$250].

Figure 2-3: Example of a choice set showing the current situation of protected areas in the Mixedwood Plains and a proposed program for expanding the protected area network.

PLEASE TREAT EACH VOTE INDEPENDENT FROM THE OTHER VOTES. NO OTHER PROTECTED AREA EXPANSION IS BEING CONSIDERED.

Protected area targets ■ **Protected land** ☐ **Normal land**	**0.6% (630 km^2)** of the Mixedwood Plains protected 	**12% (12,600 km^2 approx.)** of the Mixedwood Plains protected 
Year when protected area target is reached	Not applicable	**2016**
Your household's share of the annual investment paid through increases in taxes for the next 5 years, 2007-2011	**$0/Year for 5 years**	**$20/Year for 5 years**

Q25. Please carefully compare the two alternatives presented in the table above. If you had to vote on these two options, which one would you choose?

Please treat this vote independently from the previous vote. Please mark one box only.

Current situation	**Proposed expansion**
☐	☐

Q26. How certain are you that this is the choice you would make if this was an actual referendum?

Circle one only.

1. Very Certain 2. Somewhat Certain 3. Somewhat Uncertain 4.Very Uncertain

A full factorial would encompass all possible combinations of these attributes and levels. Using the full factorial is more desirable than employing a smaller subset of available choice sets which have poorer statistical efficiency and supply a lower level of information on respondent preferences (Louviere et al. 2000). Using all possible combinations of Coverage (1%,5%,12%), Year (2016, 2026) and Cost ($25,$60,$130,$250) a full factorial of 24 choice sets (3x2x4=24) was generated. It would be a tedious task for each respondent to complete 24 profiles of votes and therefore the sample of respondents was split into three equal blocks where each respondent would be faced with only 8 votes. This would allow the project to employ the full factorial as long as sample consistency was kept and statistical design efficiency was maintained within each block (Louviere et al. 2000; Kuhfeld 2005).

Table 2-4. Full factorial of choice sets divided into three blocks

Choice set	Block	Vote	Coverage	Time	Cost
1	1	1	12%	2026	$25
2	1	2	5%	2026	$25
3	1	3	1%	2016	$60
4	1	4	1%	2016	$130
5	1	5	12%	2016	$60
6	1	6	1%	2026	$250
7	1	7	5%	2016	$130
8	1	8	12%	2026	$250
9	2	1	5%	2026	$130
10	2	2	12%	2016	$25
11	2	3	1%	2026	$60
12	2	4	12%	2016	$250
13	2	5	1%	2026	$130
14	2	6	5%	2016	$25
15	2	7	5%	2026	$60
16	2	8	1%	2016	$250
17	3	1	12%	2026	$130
18	3	2	5%	2016	$60
19	3	3	1%	2016	$25
20	3	4	5%	2016	$250
21	3	5	5%	2026	$250
22	3	6	12%	2016	$130
23	3	7	1%	2026	$25
24	3	8	12%	2026	$60

Macros in the statistical software package SAS were used to generate three different blocks of 8 choice sets while ensuring that statistical design efficiency and orthogonality[5] was maintained[6] (Kuhfeld 2005). In order to maintain sample consistency respondents were randomly assigned with an equal one-in-three chance of responding to one of the three blocks (Salant and Dillman 1994; Kuhfeld 2005). Furthermore, in order to allow for the detection of anchoring[7] or starting point bias the order of choice sets within each block was randomized for each respondent (Herriges and Shogren 1996). Table 2-4 above shows the final layout of the choice sets within each block used in the provincial wide launch of the survey. Responses from each block were then pooled into one final dataset which was used for the statistical analysis.

2.2.2 Development of the Questionnaire

Passive use valuation requires the development of a questionnaire that provides: (1) an introduction with an overview of the general context in which the public good will be provided, (2) detailed description of the current state of the public good and the proposed changes in its quality, (3) the institutional framework which will credibly ensure the quality change will be provided, (4) a credible and consequential payment mechanism for the public good, (5) valuation scenarios that extract respondents' preferences or WTP for changes in the public good, (6) a set of debriefing questions that help explain respondents' choices in the valuation scenarios, (7) further debriefing questions to elicit respondent´s characteristics and demographic information (Carson and Flores 2001).

An in depth review of the relevant literature on passive use valuation and OMNR[8] publications on protected areas and the natural environment in Ontario, allowed for the construction of an early draft of the questionnaire while following the guidelines proposed by Carson and Flores (2001). The survey was developed between May 2006-August 2007 and passed through several stages of group discussions with Ontario Parks experts, focus groups and pre-tests before being released in August 2007 for the final data collection process. Actual surveys used for numerous passive use value studies were also consulted to gain an overview of the latest methods in questionnaire design.

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[5] Non-orthogonality is a form of statistical imbalance that causes greater variance and lower efficiency of parameter estimates.

[6] The computer output and commands used for the blocking procedure can be found in the appendix.

[7] Anchoring occurs when a vote made in the first choice set affects votes made in later profiles which can skew final willingness to pay results.

[8] OMNR: Ontario Ministry of Natural Resources

Four focus groups were organized in November 2006 with the purpose of testing the survey instrument and gaining important feedback to refine the survey design. The first focus group was held in the second week of November and consisted of 11 students of various academic backgrounds from the University of Alberta who had the primary goal of proofreading the survey instrument. The group helped detect numerous minor errors and issues with question wording, information and graphical representation which helped prepare the working draft used for three focus groups in Ontario during the last week of November 2006. One focus group consisted of Ontario Parks experts based in Peterborough while the other two were sat by members of the public in Peterborough and Thunder Bay. The public focus groups were randomly recruited by the Ontario based market research firm Opinion Source achieving a good representation of voting age citizens in Ontario. This representation was required to gain some indication of the general attitudes of the public and to ensure that various viewpoints were present during the meeting to address issues with the survey design. The public focus group members participated in a 90 minute session where they were asked to fill out the questionnaire and contribute to group discussions facilitated by two moderators. For their efforts they were compensated with a $50 honorarium.

The focus group meetings were successful in generating critical feedback for improving the layout, clarifying ambiguous sentences and removing unnecessary information. It is important to provide respondent´s with enough information about the public good without pushing their opinion for or against the public good allocation. The public focus groups found the survey providing enough information portraying the need for protected areas in southern Ontario without pushing respondents to vote for or against the protected area expansion. Many participants found the survey easy to complete and well explained in most places, giving useful step by step information describing the public good in question. Although respondents generally expressed little trouble understanding graphics, maps and figures some requested additional information in order to get accurate meaning across. Responses to the valuation scenarios were also important in assisting the selection of initial bid levels for the WTP questions.

The expert focus group was concerned that biodiversity was the sole driver of the survey while protected areas were not. They expressed that biodiversity was only a part of the benefits that protected areas provide for society and the weight should be evened out within the survey by e.g. mentioning sustainable use of resources, recreational and educational opportunities. The experts also stated that protected areas were not defined well enough within the survey and general questions should be kept at the front while moving to more specific questions later in order to maintain a logical flow within the questionnaire. Numerous suggestions on wording and content were based on these sentiments, including completely rephrasing the opening paragraph by turning the focus immediately to protected areas in the Mixedwood Plains of southern Ontario. After all important changes had been incorporated into the survey design the questionnaire was ready for an internet pilot-test which consisted of 157 members of the public of Ontario.

The pilot stage of the survey design was meant to detect any remaining ambiguities and more importantly determine the final range of the bid distribution. The pilot data provided useful information that allowed final adjustments to the cheap talk script[9] and bid vector that were successful in capturing the shape of the WTP distribution for the provincial wide launch of the survey. For further details on the development of the bid vector please consult chapter 2.2.1 that describes the valuation tools.

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[9] The cheap talk script is designed to address the issue of hypothetical bias and yea-saying. For more information on the cheap talk script please consult section 2.2.3 on hypothetical bias.

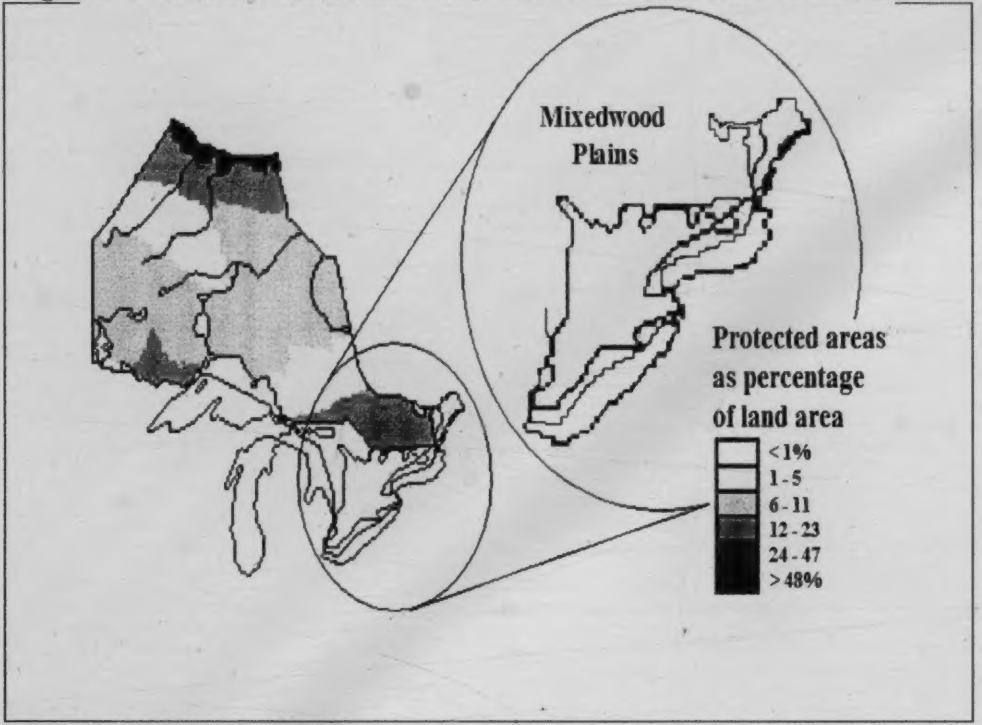
The final version of questionnaire was divided into three sections. The first section was devoted to describing the overall context in which the public good would be provided as well as the current situation in southern Ontario relating to the present state of biodiversity, coverage of protected areas and the extent of human activity in the region. The costs and benefits of expanding protected areas were also presented to make respondents aware of the major trade-offs involved in adopting such an initiative. In addition questions relating to the degree of environmental awareness and recreational activity in protected areas in southern Ontario were included to probe pro-environmental attitudes amongst the respondents and their potential effect on WTP estimates. The institutional framework was described to be led by Ontario Parks in partnership with non-profit organizations overseeing investments of public funds for protected area acquisitions, land donations and conservation easements.

The second section was dedicated to the valuation process where individual passive use values were estimated. Each respondent was faced with 8 votes proposing different programs for protected area expansions in the Mixedwood Plains versus the status quo. Before the respondents were ready to move onto the valuation scenarios the attributes describing the proposed programs were explained and the voting process as well as the method of payment clarified.

The third and final section consisted of debriefing questions eliciting the reasons participants voted the way they did in addition to general demographic questions such as age, gender, income and the number of children present in the household as well as membership in environmental organizations. The final page in the survey consisted of 15 questions designed to measure the New Ecological Paradigm (NEP) scale with the intention of gauging respondent's general attitudes towards the environment. The scale was also included to test the hypothesis that greater pro-environmental attitudes would result in a higher WTP for protected areas.

The computer-based survey allowed for the use of colourful graphs and figures and hyperlinks to display extra bits of information to interested participants without burdening other respondents with excessive information. Graphical representation, maps and questions were designed to supplement information given to respondents to help explain difficult concepts of biodiversity, human impact, the costs and benefits of a protected area expansion, and the current state of protected areas in the Mixedwood Plains. The flow of information was also arranged to be as logical as possible with concepts explained in a stepwise manner with graphics, questions and text displayed at selected intervals to give respondents a visual break from reading line after line of plain text.

Figure 2-4. Graphical representation of protected areas in southern Ontario



Source: Crins and Davis (2006)

Figure 2-4 above gives an example of the graphical representation adopted in the survey to explain the current state of protected areas in southern Ontario. For further references to the survey please consult the copy of the questionnaire included in the appendix.

Mode of administration

Multiple forms of survey administration were considered including telephone and paper based mail surveys. After weighing the pros and cons the internet mode of administration was chosen over other forms of survey administration. Internet based surveys have many appealing qualities that streamline the survey experience for respondents, reduce coding and response errors and open new venues for experimental design. An internet based survey allows for the possibility of displaying a large amount of information using colourful maps, tables and figures which can make the flow of information more appealing and easier to grasp. A computer based survey can also monitor that respondents are following instructions when filling out the survey by reminding them of their oversights and errors when they occur and preventing them from moving on to the next page when response errors are present. Data entry- and data coding errors are therefore effectively eliminated. Furthermore, programming allows for a more complex experimental design that would not be possible using a paper based survey, which includes randomizing the order of profiles, randomizing the order of questions in a table to correct for sequencing effects[10], and presenting respondents with relevant debriefing questions based on their voting behaviour[11].

The survey was administered over the internet using an internet panel maintained by the North-American wide marketing research firm Ipsos Reid. Their Ontario internet panel has over 61,538 members which is consistently maintained to represent the demographic characteristics of the public of Ontario. Although membership in the panel requires access to the internet 72% of Ontarian homes had internet access in 2005 (Statistics-Canada 2006). If upward trends in internet usage continued, the number of households connected to the internet was most likely similar or greater when the survey was implemented in August 2007.

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[10] Questions with a common theme were often grouped together into a table. E.g. questions asking respondents to rate the importance of the costs of a protected area expansion were presented in one table. The order of those questions within the table were then randomized to correct for sequencing effects.

[11] E.g. a debriefing question asking why a respondent voted for the current situation/proposed program should not be asked if the respondent never voted for the current situation/proposed program in the voting scenarios.

Valuation Scenarios

Before the valuation scenarios were presented to participants they were required to read background information describing the current situation of biodiversity, range of natural habitat, human economic activity and agriculture in the Mixedwood Plains. In addition the institutional framework behind protected area acquisition was explained, the general costs and benefits of a protected area expansion were presented and instructions were given to help respondents understand the process of voting in the scenarios. The final appropriate level of information was determined during public focus group sessions.

After reading the information, each respondent was presented with 8 votes or scenarios presenting a pair wise comparison between the status quo of protected areas in the Mixedwood Plains and a proposed program expanding the protected area network. The status quo was described by the current ratio of protected areas in the Mixedwood Plains (0.6%) while the proposed program was described by three attributes: (1) Coverage representing the proposed expansion of protected areas, (2) time needed to achieve the proposed expansion, (3) bid vector representing the cost of the program to each respondent´s household. For further details on the valuation scenarios and attributes, please consult chapter 2.2.1 on the valuation tools used in the survey.

Payment Vehicle

A properly designed payment vehicle effectively describes the method of payment for a public good and provides respondents with incentives to report their true willingness to pay. For the payment vehicle to be incentive compatible it needs to be consequential, and credibly impose costs on the entire sample of interest while avoiding voluntary contributions (Arrow et al. 1993; Carson and Hanemann 2005).

An increase in household taxes fulfills the requirements for such a payment vehicle and will credibly impose equal costs on all agents if the project is implemented. When framed as a referendum its take-it-or-leave-it approach is considered incentive compatible for respondents to reveal their true willingness to pay for public goods. On the other hand, payment vehicles based on voluntary contributions invite strategic behaviour and inflate WTP measures as respondents do not expect to be ever charged for the public good (Freeman III 2003; Carson and Hanemann 2005). On the down side, tax based payment vehicles run the risk of protest votes or "nay-saying" which is a form of rejection of the scenarios which can decrease participant´s WTP even though they approve of the proposed program. Nay-saying however did not seem to be a problem for the WTP distribution in the focus groups, pre-tests or the final provincial wide launch. On the contrary the WTP distribution was characterized by yea-saying[12] in the focus groups and pre-tests which will be covered in the next section. The final range of "bid values" for the payment vehicle can only be determined by the use of focus groups and pre-tests, as passive use values and their corresponding bid distributions are commonly not known beforehand (Champ et al. 2003). A detailed description of how the bid values were determined can be seen in chapter 2.2.1 which describes the valuation tools.

2.2.3 Hypothetical Bias

Critics of non-market valuation techniques doubt that the creation of hypothetical scenarios can convincingly replace the absence of real market transactions and draw into question the effectiveness of calibration techniques in correcting this bias. Furthermore, individuals have been known to show sympathy for sensitive issues such as environmental degradation and feel a "warm-glow" from donating money to worthy causes. Such altruistic tendencies have been known to skew WTP measures upwards as these particular respondents tend to ignore their budget constraints and the trade-offs they are making when stating their WTP. These types of respondents have been characterized in the literature as yea-sayers, in the sense that they reject the survey scenarios by blindly voting yes to valuation questions regardless of the price being asked, without considering other purchases they could have made with their available funds or the scope of the public good being offered (Carson and Hanemann 2005). The researcher needs to be certain the respondent is actually stating their WTP for the public good in question and not simply reflecting the satisfaction or "warm glow" of making the world a better place (Carson and Flores 2001).

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[12] Please consult chapter 2.2.3 on hypothetical bias for further details on this respondent characteristic.

Figure 2-5. Script used to address the issue of hypothetical bias before the valuation scenarios

When considering the votes please keep in mind:

Some people might choose to vote to keep the current situation because they think:

- It is too much money to be spent for the size and timing of the protected area expansion
- There is currently sufficient coverage of habitats in the existing protected areas network in southern Ontario
- There are other places, including other environmental protection options, where my money would be better spent

Other people might choose one of the proposed program options because they think:

- The improvement in the protected areas network is worth the money
- Biodiversity and wildlife habitats need more protection
- This is a good use of money compared to other things government money could be spent on

PLEASE NOTE: Research has shown that how people vote on a survey is often not a reliable indication of how people would actually vote at the polls. In surveys, some people ignore the monetary and other sacrifices they would really have to make if their vote won a majority and became law. We call this hypothetical bias. In surveys that ask people if they would pay more for certain services, research has found that people may say that they would pay 50% more than they actually will in real transactions.

It is very important that you "vote" as if this were a real vote. You need to imagine that you actually have to dig into your household budget and pay the additional costs.

Several methods have been suggested to mitigate hypothetical bias[13]. As indicated in the previous chapter, the use of an incentive compatible payment mechanism such as a tax based payment vehicle can mitigate hypothetical bias as it is then in the respondent´s best interest to report his or her truthful WTP. Such a payment vehicle was used in the valuation scenarios (Freeman III 2003). Cheap talk has also been proposed as the means to mitigate hypothetical bias by convincing respondents that the survey has policy implications and reminding them of the consequential trade-offs they are making in the valuation scenarios. The cheap talk script also makes respondents aware of hypothetical bias and how it can skew willingness to pay results upward. Studies by (Cummings and Taylor 1999), (List 2001a) and (Lusk 2005) have confirmed the effectiveness of cheap talk in mitigating hypothetical bias.

Figure 2-5 above shows the cheap-talk script used in the survey to address the issue of hypothetical bias and remind respondents of the consequential trade-offs they are making by voting yes or no to the proposed programs. Participants were also probed for their level of certainty following each of their choices in the valuation scenarios. If a respondent indicated any degree of uncertainty their response to that particular vote was effectively considered a vote of "no" to the proposed program. Studies have shown that hypothetical values are not statistically significant from real values when respondents are certain of their responses (Champ et al. 1997; Blumenschein et al. 1998). Furthermore, uncertain responses are not as appealing for policy guiding purposes as certain responses (Champ et al. 2003). As a result, all uncertain responses were calibrated in this fashion achieving more conservative, lower-bound estimates of the WTP function.

Yea-sayers can be identified using carefully designed debriefing questions and in appropriate cases the sample can be corrected by removing those particular respondents (Blamey et al. 1999). Table 2-5 above shows the range of questions used in the debriefing questions. 223 respondents that selected, "I believe that we should protect the natural environment regardless of the cost" as their most important reason for voting for the proposed programs were identified as yea-sayers as they showed significantly inflated WTP for the proposed programs over other respondents.

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[13] Furthermore, pictures of beautiful scenery, "cute" endangered animals or recreational activity within protected areas in the Mixedwood Plains were left out of the survey to reduce the potential "warm glow" effect their inclusion might have on respondent´s WTP.

Table 2-5. Debriefing questions probing for reasons respondents had for voting for a proposed program.

In the first column, please check all reasons that apply. In the second column, of those selected, please check THE MOST IMPORTANT REASON by marking one box only.

	Please check all that apply	**Of those selected, please check the most important reason**
I think this is a small amount to pay for the benefits received	☐	☐
I believe that we should protect the natural environment regardless of the cost	☐	☐
I feel it is the 'right' thing to do	☐	☐
It is important to invest in protecting these ecosystems for future generations	☐	☐
The program is important but I don't really think that the program will cost me directly	☐	☐
I might visit these protected areas in the future	☐	☐

2.2.4 Econometric Model

This section reviews the theory and statistical techniques used for the analysis of the respondent data. Discussion will be provided on the theory of random utility, economic valuation of the environment using willingness to pay and the econometric logit model used to estimate model parameters.

Random Utility Theory

Random utility models calculate the utility or satisfaction associated with choosing the current situation or a proposed program. Consumers are assumed to maximize their own welfare and always choose the alternative that gives them greater utility. The higher the utility associated with an alternative the more likely it is for that particular alternative of being selected. Utility is assumed to be a linear combination of a systematic and random component (Verbeek 2004):

$$U_{ij} = V(X_{ij}, Z_{ij}) + \varepsilon(X_{ij}, Z_{ij}) = V_{ij} + \varepsilon_{ij}$$

where U_{ij} represents the utility of individual j for enjoying proposed program i, V is the systematic component of utility, X_{ij} is a vector of proposed program characteristics, Z_{ij} is a vector of respondent characteristics and ε denotes the random component of utility. No econometric model can fully predict or account for all the factors that influence consumer preferences (Verbeek 2004). The theory of random utility assumes that certain elements of respondent's preferences are random and therefore cannot be predicted by the model. The error term, ε, is meant to account for this random element of consumer behaviour that cannot be explained by other means (Adamowicz et al. 1997).

The likelihood of an individual j voting for a proposed program i is equal to the probability that the utility experienced from choosing program i is greater than or equal to the utility of choosing any other available alternative, k, depicted in choice set C of individual j:

$$\begin{aligned}\Pr(i|C_j) &= \Pr\left[U_{ij} \geq U_{kj}, \text{all } k \in C_j\right] \\ &= \Pr\left[V_{ij} + \varepsilon_{ij} \geq V_{kj} + \varepsilon_{kj}, \text{all } k \in C_j\right]\end{aligned}$$

When the random utility model is developed into a binary choice model between two alternatives the dependent variable, y_{ij}, can be coded as zero when the current situation is selected and 1 when the proposed program is chosen:

$$y_{ij} = \begin{cases} 0 & \text{if individual } j \text{ chose the current situation} \\ 1 & \text{if individual } j \text{ chose proposed program } i \end{cases}$$

Using the same line of reasoning as outlined above the probability of either alternative being selected translates to:

$$\Pr(\text{Current situation}) = \Pr(y=0) = \Pr(\varepsilon_{1j} - \varepsilon_{0j} \leq V_{0j} - V_{1j})$$
$$\Pr(\text{Proposed program}) = \Pr(y=1) = \Pr(\varepsilon_{0j} - \varepsilon_{1j} \leq V_{1j} - V_{0j})$$

Let β represent the vector of parameters for the proposed program and γ the vector of characteristics of individual j. When linear utility specification is assumed the systematic component becomes:

$$V_{ij} = \beta' X_{ij} + \gamma_i' Z_j$$

When the random error component is assumed to follow a type I extreme value distribution the formula for the probability of choosing program (i) over the status quo (0) becomes:

$$\Pr(y_{1j} = 1) = \frac{\exp(V_{1j} - V_{0j})}{1 + \exp(V_{1j} - V_{0j})}$$

After substituting parameters β and γ into the deterministic component the equation becomes:

$$\Pr(y_{1j} = 1) = \frac{\exp\left[\beta'\left(X_{1j} - X_{0j}\right) + (\gamma_1 - \gamma_0)' X_j\right]}{1 + \exp\left[\beta'\left(X_{1j} - X_{0j}\right) + (\gamma_1 - \gamma_0)' X_j\right]}$$

which shows that the probability of choosing the proposed program is dependent on the difference between proposed program characteristics and respondent characteristics (Ben-Akiva and Lerman 1985; Morton et al. 1995). The logistic model will estimate the parameter values for each variable that will maximize the probability of predicting a vote of yes or a vote of no, using statistical methods of maximum likelihood. A positive parameter will indicate that increases in the relevant variable will increase the probability of voting yes while a negative parameter decreases the same probability (Verbeek 2004). Provided the marginal utility of income was estimated within the model, these parameters can then be used to estimate changes in public welfare.

Welfare Measures

The value that individuals place on the protected area network is measured as a quality change in the state of protected areas. This monetary measure assists policy makers in assessing and comparing the various impacts different programs would have on public welfare. The welfare measure that equalizes respondent's utility in both states of the world[14] is known as the compensating variation (CV) or more commonly an individual's willingness to pay (WTP) to see the quality change take place. After the proposed program has been implemented, the CV would be equal to the decrease in income necessary to move the individual j's utility back to the level it was under the current situation (Freeman III 2003).

The equation below shows how CV or WTP is calculated. Let U_0 represent respondent *j*'s utility associated with the current situation and U_1 the same individual's utility if a proposed program is implemented. To simplify let X represent the vector of all right hand side variables apart from income and its relevant parameter vector μ. Let y_j represent income of individual *j* and θ the marginal utility of income. Note that the utilities U_1 and U_0 are equal because WTP_j has been deducted from individual *j* after the proposed program is implemented.

$$U_1(y_j - WTP_j, X_1) = U_0(y_j, X_0)$$

$$\Rightarrow \quad \mu X_1 + \theta(y_j - WTP_j) + \varepsilon_{1j} = \mu X_0 + \theta y_j + \varepsilon_{0j}$$

$$\Rightarrow \quad WTP_j = \frac{X_1 - X_0}{\theta} + \frac{\varepsilon_{1j} - \varepsilon_{0j}}{\theta}$$

By denoting $X_1 - X_0 = \mathbf{X}$ and $\varepsilon_{1j} - \varepsilon_{0j} = \boldsymbol{\varepsilon}$ and assuming that the error term is distributed with a zero mean, the expected value of the willingness to pay simplifies to:

$$\Rightarrow \quad E[WTP_j] = E\left[\frac{X}{\theta}\right] + E\left[\frac{\varepsilon}{\theta}\right] = E\left[\frac{X}{\theta}\right] + 0$$

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[14] The two states of the world would be the current situation and the one experienced if the proposed program is implemented.

$$\Rightarrow \; E[WTP_j] = \frac{X}{\theta}$$

After all parameters have been estimated using the logit or probit model, this equation allows for the possibility of calculating participant's willingness to pay for proposed program implementation. The equation also shows the importance of the price variable parameter (θ) for without it welfare changes cannot be estimated (Haab and McConnell 2002).

2.3 Costs

The costs of expanding the protected area network are estimated using a hedonic model of land values in southern Ontario. The hedonic method has been frequently used in the literature to analyse land characteristics and their individual impact on land values. The following sections will briefly discuss the application of the hedonic model and how the method is used for the current cost analysis.

2.3.1 Hedonic Property Value Model

Hedonic property value models assume that land can be divided into different attributes and characteristics that influence the final market price of the property. These characteristics can be divided into income or non-income related variables which can be seen in table 2-6 (Plantinga et al. 2002).

Table 2-6. Common variables used for hedonic land valuation

Income or income proxy variables	Non-income variables
Land Productivity	Distance to transportation networks
Land Improvements	Distance to population centers
Agriculture Income	Population Density
Acreage	Land and weather characteristics
Market value of farm production	Date or Time

Income related variables explain land prices as a function of income generating opportunities inherent in the property, while non-income variables use other factors such as location, environmental amenities and time of purchase to explain variations in property values. The more desirable a land characteristic is in the eyes of buyers and sellers, the greater its contribution to final market value. The marginal contribution of each characteristic is estimated by an econometric model using the following equation:

$$P_i=P(X_i)$$

where P stands for market price, $P(X_i)$ is the functional form used for the analysis, i is land parcel i and X_i is a vector of characteristics for parcel i. The following section reviews the model and parameters used for the cost estimates of expanding protected areas in the Mixedwood Plains.

2.3.2 Land Value Parameters

Vyn (2007) conducted a hedonic land valuation study on the Greenbelt[15] using a large dataset of agricultural land from southern Ontario in 20 counties representing over 50% of the Mixedwood Plains. Just under 8,000 observations on land market transactions from 2002-2006 were provided by the Municipal Property Assessment Corporation (MPAC). Figure 2-6 below shows the location of each parcel used in the dataset in southern Ontario.

The data shows detailed descriptions of income and non-income related characteristics of each land parcel which allowed for the estimation of multiple parameters explaining land property values. The dataset was divided into land with and without structures and estimated separately for both data partitions. For the cost analysis, additions to the protected area network in the Mixedwood Plains were assumed to be pristine patches of land without structures. Therefore, characteristics for the vacant land data were used to estimate the cost of acquiring protected areas in southern Ontario. Table 2-7 below provides an overview of these variables.

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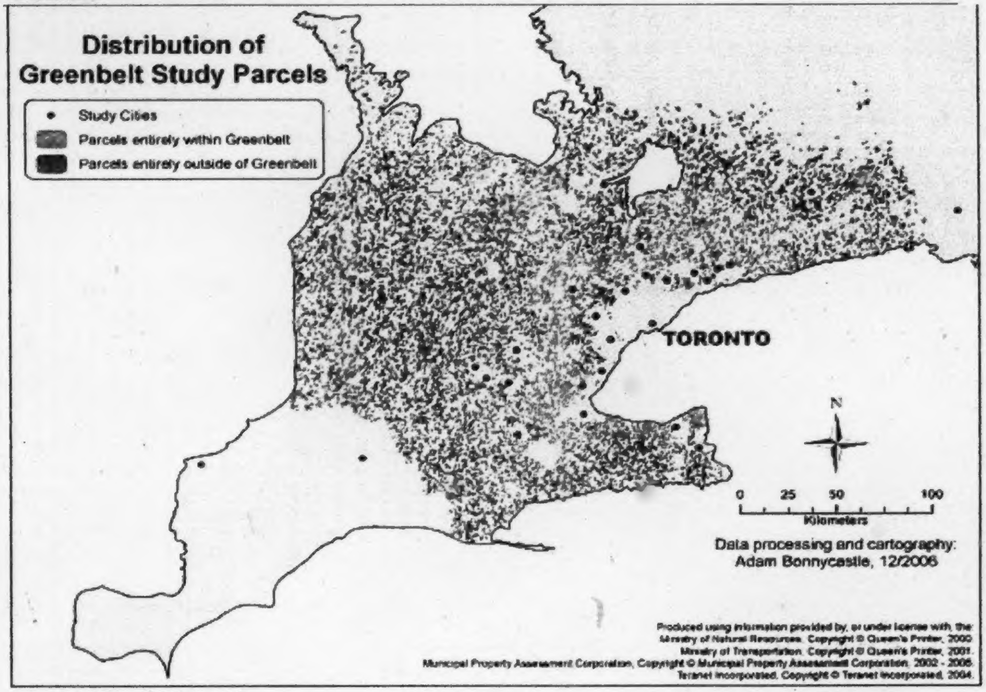
[15] Based on a legislation imposed by the Ontario government from 2004 placing a moratorium on urban development within its boundaries, the Ontario Greenbelt covers approximately 1.8 million acres of land near and around the Greater Toronto Area.

Figure 2-6. Spread of the land property transaction data in southern Ontario


Distribution of Greenbelt Study Parcels
● Study Cities
Parcels entirely within Greenbelt
Parcels entirely outside of Greenbelt
TORONTO
N
0 25 50 100
Kilometers
Data processing and cartography: Adam Bonnycastle, 12/2006
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Source: (Vyn 2007) p.29

The variables were separated into “greenbelt variables” which represented different regions within the greenbelt; “land quality variables” which stood for parcel size, land capability for agriculture and other harvesting activity; “neighbourhood amenity variables” which used population density, population growth rate and access to water or sewer as explanatory factors; “location variables” providing a dummy for the county in which the property was sold; and finally “other variables” representing time of sale, the constant and whether the sale was speculative in nature. The second step in estimating the costs of increasing protected areas in the Mixedwood Plains was to get experts at Ontario Parks to select areas that were considered priority additions to the protected area network. Due to budget, logistics and time limitations only one ecodistrict (6E-12) was selected on the south-eastern border of Ontario and Quebec. This ecodistrict will now be examined in further detail.

Table 2-7. Explanatory variables in the Greenbelt hedonic property model with summary statistics

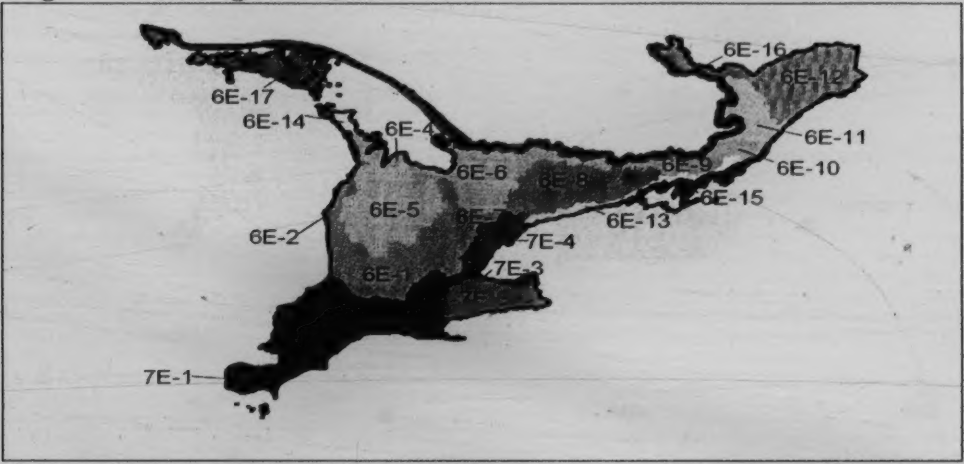
		Vacant Land (1,935 Sales)	
Variable	**Definition**	**Mean**	**Std. Deviation**
Greenbelt Variables			
PC	=1 if parcel is located in the Protected Countryside	0.1044	0.3058
ORM	=1 if parcel is located in the Oak Ridges Moraine	0.0439	0.2050
NE	=1 if parcel is located in the Niagara Escarpment	0.0253	0.1571
PC intermediate	=1 if parcel is located in the PC and sold between November 2003 and June 2004	0.0171	0.1295
ORM intermediate	=1 if parcel is located in the ORM and sold between November 2003 and June 2004	0.0103	0.1012
NE intermediate	=1 if parcel is located in the NE and sold between November 2003 and June 2004	0.0057	0.0752
PC post-GB	=1 if parcel is located in the PC and sold after June 2004	0.0455	0.2084
ORM post-GB	=1 if parcel is located in the ORM and sold after June 2004	0.0196	0.1388
NE post-GB	=1 if parcel is located in the NE and sold after June 2004	0.0098	0.0986
PC post-GB X GTA	Interaction term between distance to the GTA and parcels in the PC sold after June 2004	0.9773	5.6904
ORM post-GB X GTA	Interaction term between distance to the GTA and parcels in the ORM sold after June 2004	0.1909	2.6143
NE post-GB X GTA	Interaction term between distance to the GTA and parcels in the NE sold after June 2004	0.5095	6.7340
Land Quality Variables			
Lot size	Size of parcel, in acres	63.4833	43.9866
Class 1 land	Percentage of parcel in Class 1 land	0.2871	0.4049
Class 2 land	Percentage of parcel in Class 2 land	0.3233	0.3766
Wooded area	Percentage of parcel in wooded area	0.0983	0.1840
Organic soil	Percentage of parcel with organic soil	0.0027	0.0489
Heat units	Number of crop heat units	2,736.8124	198.0269
Orchard/vineyard	=1 if parcel has orchards or vineyards	0.0114	0.1060
Neighbourhood and Amenity Variables			
Pop density	Township population density, number of people per km^2	143.8736	339.0359
Growth rate	Township opulation annual growth rate from 2001 to 2006	1.3132	2.0593
Water/sewer	Accessibility to water and sewer services	0.3390	0.4735
Location Variables			
GTA	Distance to the Greater Toronto Area, in kilometres	61.8195	45.2796
Town	Distance to the nearest town (population>2,000), in km	17.5493	9.6862
Brant	=1 if parcel is located in Brant County	0.0196	0.1388
Bruce	=1 if parcel is located in Bruce County	0.0677	0.2513
Dufferin	=1 if parcel is located in Dufferin County	0.0393	0.1943
Durham	=1 if parcel is located in Durham County	0.0693	0.2539
Grey	=1 if parcel is located in Grey County	0.0853	0.2794
Hald-Norfolk	=1 if parcel is located in Hald-Norfolk County	0.0620	0.2412
Halton	=1 if parcel is located in Halton County	0.0331	0.1789
Hamilton	=1 if parcel is located in Hamilton County	0.0171	0.1295
Huron	=1 if parcel is located in Huron County	0.0786	0.2691
Kawartha	=1 if parcel is located in Kawartha County	0.0424	0.2015
Niagara	=1 if parcel is located in Niagara County	0.0568	0.2316
Northumberland	=1 if parcel is located in Northumberland County	0.0279	0.1647
Oxford	=1 if parcel is located in Oxford County	0.0537	0.2256
Peel	=1 if parcel is located in Peel County	0.0553	0.2286
Perth	=1 if parcel is located in Perth County	0.0362	0.1868
Peterborough	=1 if parcel is located in Peterborough County	0.0336	0.1802
Simcoe	=1 if parcel is located in Simcoe County	0.1204	0.3255
Waterloo	=1 if parcel is located in Waterloo County	0.0129	0.1130
York	=1 if parcel is located in York County	0.0403	0.1967
Gravel road	=1 if parcel is located on a gravel road	0.0377	0.1906
Other Variables			
Month	Month time trend	25.7819	14.4237
Speculative	=1 if parcel was deemed a speculative sale	0.0093	0.0960

Source: Vyn (2007) p.32

2.3.3 Ecodistrict 6E-12

Ontario is divided into three separate ecozones, the Hudson Bay Lowlands, the Ontario Shield and the Mixedwood Plains. These ecozones are further split into ecoregions which are in turn subdivided into even smaller ecodistricts. Each of these partitions harbour distinct ranges of natural habitats which differentiate them from the other regions. Ecodistrict 6E-12 was chosen for the cost analysis due to the low level of protected areas within its borders and high degree of important habitat in need of representation. Ecodistrict 6E-12 contains the counties of Prescott & Russell; Stormont, Dundas & Glengarry; and Ottawa. Figure 2-7 below shows the ecoregions and ecodistricts in the Mixedwood Plains of southern Ontario as well as ecodistrict 6E-12 highlighted in green.

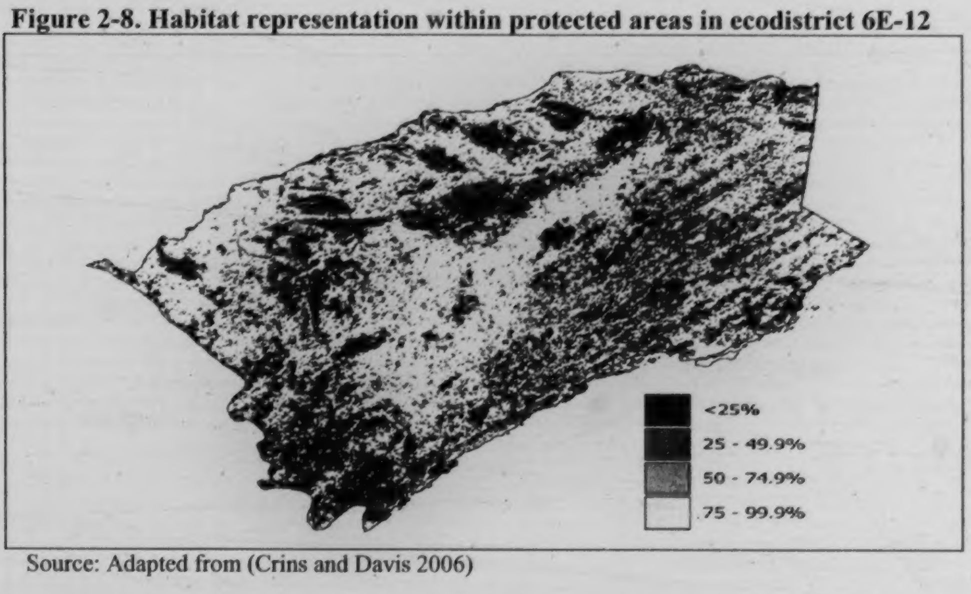
Figure 2-7. Ecoregions and ecodistricts in the Mixedwood Plains



Source: Adapted from (Crins and Davis 2006)

Ontario Parks uses a habitat representation approach when selecting suitable areas to expand the protected area network. For administrative purposes habitat is considered to be split into two features of land and vegetation. Adequate representation is considered achieved when 1% or 50 hectares of each available land and vegetation association have been protected within each ecodistrict (Crins and Davis 2006). These potential representative areas are located using Conservation Planning Software, also known as C-plan to determine the level of irreplaceability or ecological importance. Another computer based method, Gap analysis, is then performed to determine how well these areas fill gaps in representation. Results from these two software tools help experts to determine an order of priority for protected area acquisition.

Figure 2-8. Habitat representation within protected areas in ecodistrict 6E-12



Source: Adapted from (Crins and Davis 2006)

Figure 2-8 above shows the level of representation achieved within ecodistrict 6E-12. The colour coding ranges from red which shows habitat with less than 25% representation achieved, to white where 100% habitat representation has been achieved (Davis 2005). Experts at Ontario Parks performed such an analysis on 6E-12 in March 2007 and selected 28 parcels of land that met their conservation targets criteria. These parcels were then organized in order of priority based on their importance for conservation and need for habitat representation.

These parcels formed the basis of the cost estimation. Using Geographic Information System (GIS) software, variables conveying information on location, size and agricultural land capability were linked to each parcel. Combining these variables with the parameter estimates from the Green Belt study by Vyn (2007) and sequencing the parcels in order of increasing costs it was possible to plot a total cost curve showing the least costs for any given level of protection in 6E-12. These cost curves are covered in further detail in chapter 3.6.

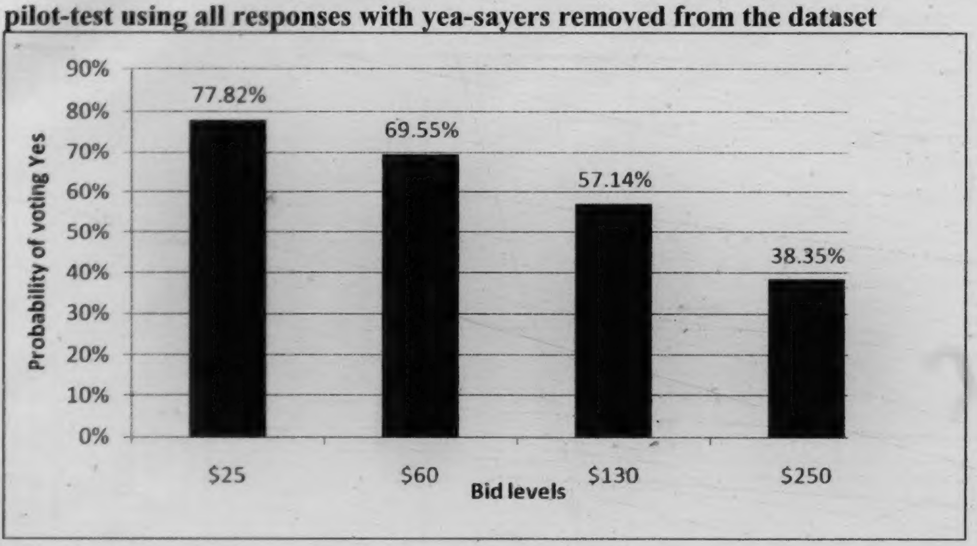
3 Results

The results are divided into seven sections: (1) beginning with a discussion of the pilot test results; (2) followed by the presence of yea-sayers; (3) general responses to survey questions; (4) description of the survey data; (5) then a discussion of the benefits of expanding protected areas; (6) after which the estimated costs for expanding protected areas in ecodistrict 6E-12 will be addressed. (7) Finally the cost and benefit curves will be jointly analysed to determine the optimal allocation of protected areas within 6E-12.

3.1 Pilot Test Results

Figure 3-1 below shows the WTP distribution for all responses regardless of the proposed program. Each column represents the probability that a respondent would vote yes to a proposed program at the specified bid level. Based on final model results, the WTP distribution should shift downwards when the 1% expansion is considered but upwards for the 12% expansion. As can be seen in figure 3-1 it turned out that the bid distribution in the pilot-test was not sufficient in capturing the mean of the distribution and left fat tails on either end of the distribution.

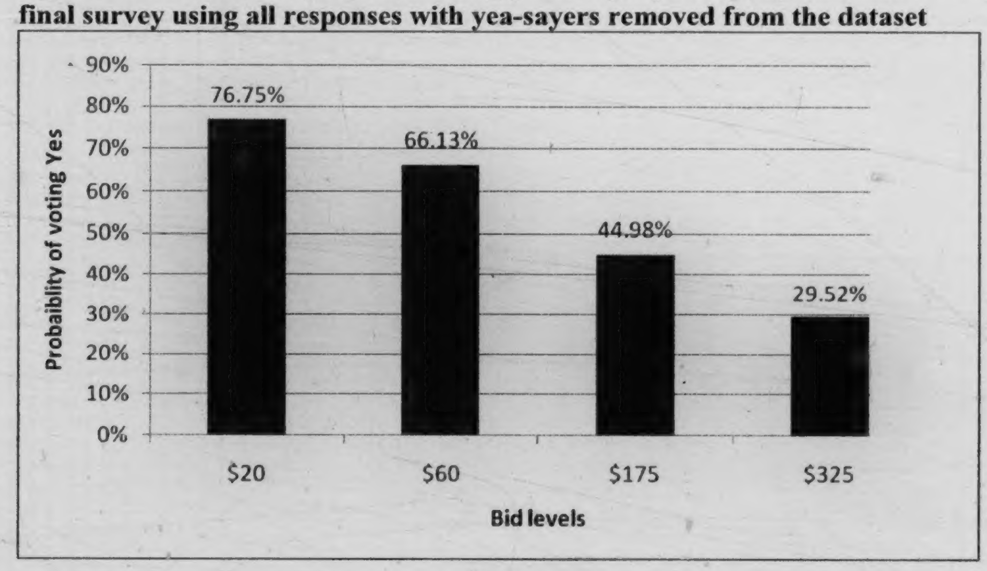
Figure 3-1. Ratio of respondents voting yes to a proposed program in the pilot-test using all responses with yea-sayers removed from the dataset



This was despite the fact that yea-sayers[16] were removed from the analysis. In order to account for this the upper two bids were adjusted upwards and the lowest bid downwards forming the final bid vector used in the provincial wide launch of the survey: [$20,$60,$175,$325]. The cheap talk script[17] was also adjusted to remind respondents more clearly of the trade-offs they were making when voting in the valuation scenarios and that they had to imagine that they had to actually dig into their household budget to pay for the proposed programs.

Figure 3-2 shows that the final bid design along with the cheap talk script was more efficient in capturing the shape of the WTP distribution. The 50% point of the distribution was captured by the center bids ($60 and $175) and the whole range of the bid vector covered a larger range of the WTP function than in the pilot-test.

Figure 3-2. Ratio of respondents voting yes to a proposed program in the final survey using all responses with yea-sayers removed from the dataset



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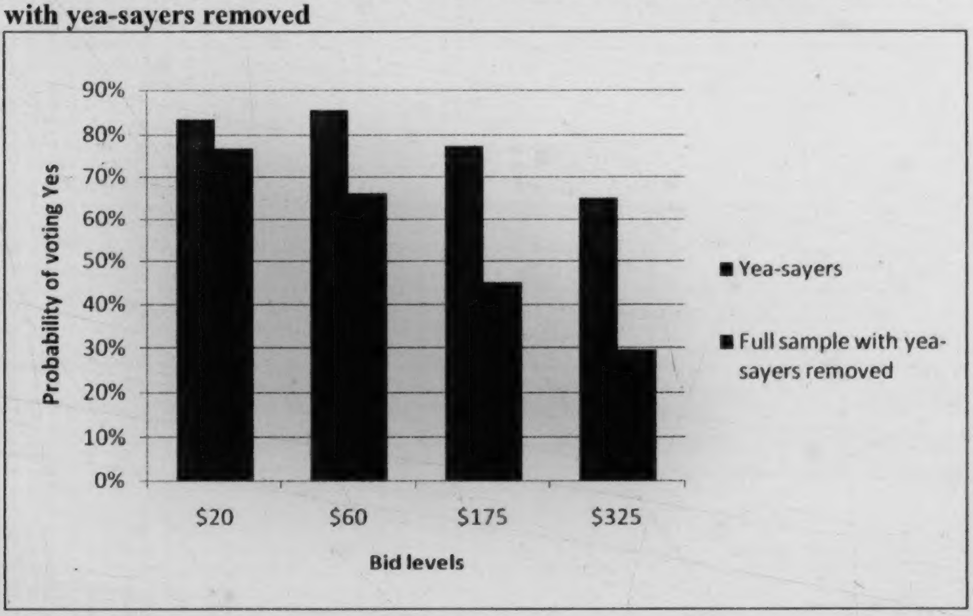
[16] Please consult section 2.2.3 on hypothetical bias for further details on this respondent characteristic.

[17] Please consult section 2.2.3 on hypothetical bias for further information on the cheap talk script.

3.2 Yea-Sayers

Using procedures described in chapter 2.3 which discusses hypothetical bias, 223 or 13.7% of respondents were identified as yea-sayers. Figure 3-3 below shows the radically different WTP distribution that yea-sayers generated in the valuation scenarios. As the graph shows the yea-sayer responses were characterized by significantly higher ratio of yes responses compared to the WTP distribution where the yea-sayers were removed. The distribution had a large fat tail on the higher end of the bid vector and exhibited a lack of sensitivity to price between the $20 and $60 bids. These responses would make statistical analysis of the WTP function difficult without overestimating the true WTP as the fat tail has the effect of skewing WTP results upwards while there is no way of pinpointing the 50% center of the distribution with the available data. These 223 respondents where therefore removed from the dataset.

Figure 3-3 Final survey responses: Ratio of yea-sayers voting yes to a proposed program compared to the WTP distribution using the full sample with yea-sayers removed



3.3 Survey Data

The marketing research firm Ipsos Reid collected the survey response data in August 2007 over the internet using their established panel of 61,538 respondents. Their panel is maintained to be demographically representative of the public of Ontario and therefore employing their panel will simulate sampling conditions in a province-wide poll. Table 3-1 shows the response rate to the survey. Out of 4,392 email invitations, 1,629 respondents completed the survey which translates to a 37.09% overall response rate. 1,464 email invitations were sent to each of the three blocks and response rates ranged from 35.66%-38.80%.

Table 3-1. Response rates within each of the three blocks[1]

	Block 1	Block 2	Block 3	Total
Email Invitations	1,464	1,464	1,464	4,392
Completed Surveys	522 (35.66%)	539 (36.82%)	568 (38.80%)	1,629 (37.09%)
Accessed only	48 (3.27%)	35 (2.39%)	42 (2.87%)	125 (2.85%)
Incompletes answering at least Q1	124 (8.47%)	120 (8.20%)	122 (8.33%)	366 (8.33%)

[1] Percentages in the parenthesis represent the response ratio of email invitations within each block.

2.85% of respondents accessed the survey without answering any questions while 8.33% started answering the survey without completing the questionnaire. The experimental design required the respondents to be randomized equally between the three blocks. Table 3-2 below shows that the randomization between the three blocks was successful with 32.04%-34.87% of the total sample responding to each of the three blocks.

Table 3-2. Ratio of respondents within each of the three blocks[1]

	Block 1	Block 2	Block 3	Total
Ratio of total responses	522 (32.04%)	539 (33.09%)	568 (34.87%)	1629 (100%)

[1] Percentages in the parenthesis represent the number or respondents as a ratio of total respondents

People were genuinely pleased with their survey experience and table 3-3 below shows that it scored higher than 85%-99% of other Ipsos Reid surveys in three categories.

Table 3-3. Respondent´s feedback on their survey experience

100% = Panelists enjoyed the survey 0 % = Panelists disliked the survey	Learned something new	Survey was meaningful	Fun to answer	Length
Rank Percentile	98%	99%	85%	50%

The percentiles show how the survey ranked relative to all other surveys administered by Ipsos Reid. Despite ranking low on length it scored better than 98% of other surveys for teaching the respondents something new, 99% for being meaningful and 85% for being fun to answer.

Table 3-4. Age structure of the sample versus the population of Ontario

Age Characteristics	Full Sample	Ratio	Sample without yea-sayers	Ratio	Population of Ontario	Ratio
18-19	24	1.14%	23	1.27%	333.246	2.74%
20-24	58	2.77%	47	2.60%	797.255	6.56%
25-29	140	6.68%	126	6.96%	743.695	6.12%
30-34	157	7.49%	135	7.46%	791.955	6.51%
35-39	128	6.11%	108	5.97%	883.990	7.27%
40-44	196	9.35%	168	9.29%	1.032.415	8.49%
45-49	203	9.68%	173	9.56%	991.970	8.16%
50-54	141	6.73%	124	6.85%	869.400	7.15%
55-59	143	6.82%	125	6.91%	774.530	6.37%
60-64	73	3.48%	62	3.43%	581.985	4.79%
65-69	203	9.68%	174	9.62%	466.240	3.83%
70-74	98	4.67%	87	4.81%	401.950	3.31%
75-79	45	2.15%	38	2.10%	338.910	2.79%
80-84	14	0.67%	11	0.61%	250.270	2.06%
85-99	6	0.29%	5	0.28%	191.810	1.58%
Median Age	**42**		**39**		**39**	

Table 3-4 above shows the age structure within the sample. For respondents aged 25-59 the age structure is very similar to the one reported for the public of Ontario by Statistics Canada census data from 2006. There is clearly an overrepresentation in some pensioners between 65-74 years of age and underrepresentation in the youngest and oldest age groups. The oldest age groups are most likely less familiar with computers and might not have access to the internet which could explain the low response rate. The low ratio of 18-24 year olds is harder to explain without additional information on the demographic structure of the original email invitations. Using procedures described in chapter 2.3 which discuss hypothetical bias, 223 or 13.7% of respondents were identified as yea-sayers. Removing the yea-sayers did not have any significant effects on the overall age structure. The median age for the original data was 42 while the median age of the data without the yea-sayers was identical to the provincial median age of 39.

Table 3-5. Socio-demographic characteristics of the sample versus the population of Ontario

Characteristic	Full Sample	Sample without yea-sayers	Population of Ontario[a]
Number of respondents	1,629	1,404	12,160,285
% Male	49.5%	49.5%	48.77%
Median household Income[b]	\$60,000-\$69,999	\$60,000-\$69,999	\$60,000-\$69,999[c]
% Married	57.90%	58.97%	51.94%
Average household size	2.84	2.86	2.60
Median Age	42	39	39
Resident of northern Ontario	8.36%	8.54%	6.94%
Member of an environmental organization	6.14%	5.70%	-
Visited a protected area in southern Ontario	52.85%	52.35%	-

[a] Source: (Statistics Canada 2007)

[b] Based on a forecast from the reported median income in 2005 using average increase in income 2001-2005.

[c] Ipsos Reid provides income brackets rather than specific income values

Table 3-5 above compares socio-demographic characteristics of the sample versus the population of Ontario. The comparison shows that, except for the overrepresentation of married couples and people living in northern Ontario, the sample simulates the population characteristics fairly well with income, gender ratio, household size and median age close to the public of Ontario. Additional information is provided on membership in an environmental organization and whether the respondent had visited a protected area in southern Ontario. Unfortunately there were no data available for the actual level of these characteristics within the population of Ontario.

3.4 General Responses to Survey Questions

Respondents ranked environmental protection as second in priority after health care. Over two thirds of respondents wished to see more provided of all the available public goods with the exception of the arts while at the same time wanting to see lower taxes.

Table 3-6. Question 1[illegible] General Attitudes Towards Public Goods

Total respondents = 1629	Do a lot more	Do more	Do about the same	Do less	Do a lot less
Improving health care	802 49%	635 39%	165 10%	22 1%	5 0%
Protecting the natural environment	672 41%	617 38%	298 18%	35 2%	7 0%
Improving education	537 33%	734 45%	331 20%	22 1%	5 0%
Reducing crime	638 39%	622 38%	335 21%	28 2%	6 0%
Improving roads and highways	438 27%	770 47%	385 24%	30 2%	6 0%
Lowering taxes	561 34%	556 34%	415 26%	70 4%	27 2%
Encouraging economic growth	337 21%	758 47%	498 31%	29 2%	7 0%
Increasing job opportunities in rural communities	392 24%	683 42%	480 30%	61 4%	13 1%
Supporting the arts	113 7%	332 20%	839 52%	258 16%	87 5%

Respondents were also probed for their attitudes towards the potential costs and benefits involved in expanding the protected area network in the

Mixedwood Plains. Below, two tables with questions 10 and 11 give an overview of their responses ranked in order of importance.

Table 3-7. Q10: Below are some POSSIBLE BENEFITS of increasing the provincial protected area network in the Mixedwood Plains. In your opinion, how important do you think each of these benefits are?

Base: All Respondents	Extremely important	Very important	Slightly important	Not important
1. Natural habitat to protect wild animals and plants from human development	932 57%	552 34%	134 8%	11 1%
2. Availability of places to help maintain ecological processes	879 54%	600 37%	139 9%	11 1%
3. Enhancement of education	568 35%	747 46%	289 18%	25 2%
4. Availability of places for people to pursue outdoor recreation activities	311 19%	767 47%	480 29%	71 4%
5. Stimulation of local economies through tourism	222 14%	622 38%	666 41%	119 7%

Table 3-8. Q11: Below are some POSSIBLE CONCERNS from increasing the provincial protected area network in the Mixedwood Plains. In your opinion, how concerned are you about the following issues?

Base: All Respondents	Extremely concerned	Very concerned	Slightly concerned	Not concerned
1. Government costs of acquiring protected areas reduces public funding that can be spent elsewhere	151 9%	351 22%	810 50%	317 19%
2. Slower growth in the Ontario economy	139 9%	362 22%	755 46%	373 23%
3. Restrictions placed on land development within protected areas	176 11%	313 19%	576 35%	564 35%
4. Limits on certain outdoor recreation activities	139 9%	294 18%	665 41%	531 33%
5. Limits placed on urban development	130 8%	276 17%	479 29%	744 46%

Responses to question 10 and 11 are ranked in order of importance by pooling the "extremely important/concerned" and "very important/concerned" categories. Respondents expressed the opinion that natural habitat to protect wild animals and plants from human development was the most important benefit of protected areas. Second in importance was their function as places to help maintain ecological processes and third their potential enhancement of educational opportunities. People placed least relative importance on recreational activity and economic benefits to local communities.

Participants were most concerned with potential government expenditures in expanding the protected area network. Potential impacts on the Ontario economy were ranked second and restrictions placed on land development ranked third. One third of respondents seemed not at all concerned with limits places on recreational activities and almost half the sample expressed no concern at all for limits placed on urban development. It is interesting to note that at least 19% of the full sample[18] always stated that they had no concerns with any negative impacts a protected area expansion might have.

3.5 Benefit Estimates

The benefits associated with expanding protected areas in the Mixedwood Plains are estimated using a willingness to pay function calculated at different levels of protected area coverage. The following sections address: the validity of the willingness to pay estimates using the scope test; variables used in the analysis; the willingness to pay function per proposed program; willingness to pay estimates aggregated over the entire population of Ontario; and finally the public willingness to pay for additional protected areas in ecodistrict 6E-12.

3.5.1 Validity of the Estimated Willingness to Pay: The Scope Test

The scope test has been suggested as a means to test the validity of welfare estimates in contingent valuation studies. If respondents are sensitive to scope it means they took the hypothetical scenarios seriously and considered the relevant trade-offs posed to them by the proposed programs. When respondents are sensitive to scope they should be WTP more for a greater provision of the public good (Champ et al. 2003). The following scope test in table 3-9 was performed on the WTP estimates using parameters from model 1 in table 3-11 (see below) using responses to the first valuation question only. First responses were selected in order to perform the test without any sequencing or anchoring effects. The test results from table 3-9 show that respondents are sensitive to scope at every level of coverage. The WTP results are therefore credible and useful for further analysis.

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[18] This result dropped slightly to 17.3% after yea-sayers were removed. Therefore, this result cannot be attributed to yea-sayers alone.

Table 3-9. Scope Test: 1st Vote Only

WTP	Time Pooled
WTP 1% expansion	$ 103.96
WTP 5% expansion	$ 195.97
WTP 12% expansion	$ 231.37

3.5.2 Specifications of the Valuation Models

Several model specifications were used to estimate participant's WTP for the proposed programs. In all cases the dependent variable was Vote indicating the Yes or No response to a proposed program. The independent variables were divided into three categories: design variables, demographic variables and endogenous variables. The design variables represent the attributes of coverage, time and price (as described in chapter 2.2.1), which are the main factors used to describe the proposed programs. Demographic variables used individual characteristics such as income, sex, age, number of children in the household and residency to help determine voting behaviour. Variables describing environmental sentiments were based on responses to survey questions and are therefore likely to be endogenous. The independent vote variable can be thought of as measuring people's preferences or enjoyment for consuming environmental resources. These same preferences could also be driving the level of the variables that describe environmental sentiments.

Table 3-10. Statistics and descriptions of variables used in the logit analysis

N=11,232 observations

Variable	Type	Mean	St. Dev.	Min	Max	Description
Design Variables						
VOTE	Dummy	0.54345	0.4981	0.000	1.000	Vote=1 if Yes Vote=0 if No
PRICE	Continuous	145.000	118.49	20.00	325.0	Four different levels of the bid vector ($20, $60, $175, $325).
COVERAGE	Continuous	6.0034E-02	4.5395E-02	0.010	0.120	The three different levels of protected areas (1%, 5% and 12%).
COV2	Continuous	5.6646E-03	6.2471E-03	1.0E-04	0.014	COV2=Coverage*Coverage
LNCOV	Continuous	-3.2380	1.0273	-4.605	-2.120	LNCOV=Ln(Coverage)
T2026	Dummy	0.5000	0.50002	0.000	1.000	T2026=1 if protected area targets are reached in 2026, T2026=0 if reached in 2016.
Demographic Variables						
INCOME	Continuous	74074	41019	5000	1.65E+05	Scalar divided into 16 income brackets.
GENDER	Dummy	0.4943	0.49999	0.000	1.000	Gender=1 if male, Gender=0 if female
AGE	Continuous	48.246	15.638	18.00	92.00	Age of participant ranging from 1-99 years.
HHKIDS	Continuous	0.61681	0.99069	0.000	7.000	Number of children in household.
NONT	Dummy	0.08547	0.27959	0.000	1.000	NONT=1 if a resident of northern Ontario NONT=0 if a resident of southern Ontario
Environmental Attitude Variables:						
Q5	Dummy	5.6980E-02	0.23181	0.00	1.00	Q5=1 if a member of an environmental organization, Q5=0 otherwise
Q6	Dummy	0.52350	0.49947	0.00	1.00	Q6=1 if visited a protected area in southern Ontario, Q6=0 otherwise
NEP	Continuous	55.472	9.0808	20.00	75.00	NEP score

Separating the cause and effect, whether the voting behaviour is determining the level of the environmental variables or whether environmental sentiments are affecting the probability of voting yes can therefore be problematic. As a specification test, models including these endogenous variables were estimated to confirm that the attitudinal scale responses were consistent with the voting responses.

The bid distributions and results from general survey and debriefing questions were used to estimate standard binary logit models to determine the Ontarian WTP for expanding protected areas in southern Ontario. Data analysis was performed in Shazam, an econometric software package. A total of 8 observations were generated per respondent, one observation per vote in the voting scenarios. This made up for a total of 1,629*8=13,032 observations. After removing 223 yea-sayers the sample size was reduced to 11,248 observations. Furthermore, in order to test for regional differences in WTP, two respondents that could not be located geographically within Ontario were also removed from the dataset reducing the final number of observations to 11,232.

Table 3-10 above shows the variables used for the econometric analysis with information on variable type, mean, standard deviation, variance, minimum and maximum value and a description of variable characteristics. Two types of variables, continuous (qualitative) and discrete dummies (quantitative) were included in the analysis. Continuous variables represented price, different forms of coverage, income, age, number of children in the household and the NEP scale which gauges environmental attitudes of each respondent[19], while dummies described vote, time (T2026), gender and geographic location of respondents within Ontario.

3.5.3 Willingness to Pay Per Proposed Program

Table 3-11 below depicts three different specifications for the econometric analysis. With the addition of the constant, model 1 provides the design variables only (Coverage, T2026 and Price), model 2 adds the demographic variables while model 3 adds the potentially endogenous environmental attitude variables.

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[19] The NEP scale is defined in Appendix E which covers environmental attitudes.

Table 3-11. WTP logit models for three different specifications for the design, demographic and environmental attitude variables[1]

	Model 1	**Model 2**	**Model 3**
Dependent variable: Probability of being willing to pay a specified price level			
Intercept	0.80022** (17.396)	0.42206** (4.3509)	-2.1517** (-12.919)
Price of the proposed program	-0.0066894** (-37.102)	-0.0067350** (-37.162)	-0.0070431** (-37.655)
Coverage of protected areas	6.3036** (13.789)	6.3301** (13.792)	6.6177** (14.107)
Time: Expansion completed in 2026	-0.046396 (-1.1310)	-0.045960 (-1.1170)	-0.046123 (-1.0976)
Household Income		2.0857E-06** (4.0482)	2.1644E-06** (4.100)
Male gender		-0.085991* (-2.0647)	0.021240 (0.49153)
Age of respondent		0.0068975** (4.9131)	0.0041318* (2.8689)
Number of children in the household		-0.086899** (-3.9341)	-0.076167** (-3.3680)
Resident of northern Ontario		-0.082361 (-1.1175)	-0.055619 (-0.7360)
Q5: Member of an environmental organization			0.42899** (4.3841)
Q6: Visited a protected area in southern Ontario			0.16146** (3.7487)
NEP: New Ecological Paradigm			0.046270** (18.836)
Obs.	11232	11232	11232
Log-likelihood	-6886.8	-6850.5	-6621.5
Log-likelihood (0)	-7743.0	-7743.0	-7743.0
P-value chisquare (d.f.=x)	0.000 (d.f.=3)	0.000(d.f.=8)	0.000 (d.f.=10)
McFadden R^2	0.11058	0.11526	0.14484
% correct predictions	67.61%	67.49%	69.46%
Household WTP 1% Expansion	**$125.45**	**$125.77**	**$125.72**
Standard Deviation	**$4.56**	**$4.52**	**$4.47**
Household WTP 5% Expansion	**$163.34**	**$163.32**	**$163.37**
Standard Deviation	**$3.13**	**$3.13**	**$3.14**
Household WTP 12% Expansion	**$229.23**	**$229.22**	**$229.13**
Standard Deviation	**$5.38**	**$5.44**	**$5.33**

[1] t-statistics under parenthesis.

*Statistically significant at the 95% level.

**Statistically significant at the 99% level.

The constant represents the utility of the proposed program independent of the design variables while the other parameters represent the effect changes in their values will have on the probability of voting yes to a proposed program. When the parameter is positive, increases in the variable will raise the probability of voting yes while a negative parameter will decrease the same probability. In all three model specifications most parameters were statistically significant at the 95%-99% level with extremely high and robust statistical significance for coverage and price as indicated by their high *t*-stat scores.

Statistically significant parameters retained similar parameter estimates between the three different models and did not alternate in sign. As explained in chapter 2.2.4 the mean WTP was calculated by summing up the product of the mean of each variable and its corresponding parameter and dividing the sum by the parameter estimate on the price variable. Standard deviations of the WTP were calculated using the Krinsky-Robb procedure with 1,000 draws from the normal distribution (Krinsky and Robb 1986). Uncertain responses were treated as "no" and yea-sayers were removed which means the WTP estimates serve as a lower bound or conservative estimates for the public's WTP for a protected area expansion in the Mixedwood Plains.

Model 1: Design variables

Model 1 estimated parameters for the three design variables only. All variables exhibited intuitively correct parameter estimates with only the time variable being statistically insignificant. The price parameter remained negative and statistically significant from zero which is in accordance with the well known economic theory that demand for goods should drop when their prices increase. Respondents were therefore sensitive to increases in the cost of the proposed programs by lowering their probability of voting yes. The positive parameter on coverage showed that the higher levels of coverage increase the chance of respondents voting yes. This suggests that the participants increase their utility when the protected area network is expanded and they prefer a larger expansion to a smaller one. The time variable (T2026) had the expected negative sign that respondents preferred the expansion to take place sooner in

2016 rather than later in 2026. However, the parameter was not statistically significant from zero which corresponds with the fact that the majority of respondents indicated in the debriefing questions that they ignored the time variable when making their choices. At a glance the combined results of the design variables suggest that the public prefers a large protected area expansion at a reasonable price while placing a low emphasis on when the expansion should be completed.

Model 2: Design variables + demographic variables

Having more children living in the household also decreased the chance of voting yes to a proposed program, probably due to the fact that additional expenditures necessary to raise children place a constraint on available household income that can be spent elsewhere. Residency in northern Ontario also seemed to have a negative effect on the probability of voting yes. However the parameter was not statistically significant from zero which could be due to heterogeneous preferences or the low number of respondents living in northern Ontario within the sample. Being male seemed to decrease the probability of voting yes to a protected area expansion. This result was echoed in the analysis of the NEP scale[20] which showed that males had a statistically significant lower NEP scores and therefore pro-environmental attitudes than females. The positive effects of income show the logical result that wealthier respondents can more easily afford the extra expenditures needed to support the proposed programs. The positive parameter on age is harder to explain but the results might suggest that the older generation has a greater sense of responsibility to leave the natural environment in the Mixedwood Plains intact for future generations.

Adding the demographic variables did not alter the statistical significance or the parameter estimates of the design variables. Predictive power dropped slightly from 67.61% to 67.49% between the two models while McFadden's R^2 was slightly higher in model 2 than model 1, but that could also be attributed to the fact that there are a greater number of parameters in model 2. To test the two different model specifications the log-likelihood ratio test[21] was performed at the 1% significance level which confirmed that model 2 is superior to model 1.

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[20] Please consult the appendix for a more detailed discussion of voting behaviour.

Model 3: Design variables + demographic variables + environmental variables

The positive parameters for the environmental variables indicate that greater environmental sentiments and awareness measured by the NEP scale, as well as respondent's direct use of protected areas and membership in environmental organizations increase individual support for a protected area expansion. Adding the environmental variables seemed to improve the goodness-of-fit measures from model 2 increasing McFadden´s R^2 to 14.5% and predictive power to 69.46%. The log-likelihood ratio test also confirmed that model 3 was superior to model 2 at the 1% significance level. The appendix contains further analysis of the environmental variables and respondent´s attitudes towards the environment. The design- and demographic variables retained their statistical significance and parameter signs while the parameter values changed slightly with the price parameter being slightly lower and the parameter on coverage slightly higher. The parameter for the male gender however, lost its statistical significance which could be attributed to a correlation with the NEP variable which is further discussed in the appendix on environmental attitudes.

Based on the goodness-of-fit measures; McFadden´s R^2, the percentage of correct predictions and the log-likelihood ratio test, model 2 did not seem to improve model 1 very much with only slight improvements in the R^2 and log-likelihood function and a tiny decrease in predictive power. Model 3 on the other hand seems superior to the other two specifications and had the highest R^2 and predictive power correctly anticipating yes and no responses 69.46% of the time. The superiority of model 3 over the other two models was also confirmed by the log-likelihood ratio test at the 1% significance level. The expected household WTP for a 1% expansion was little over \$125, \$163 for the 5% expansion and \$229 for the 12% expansion. Using different model specifications did not seem to affect the WTP results which remained virtually statistically undistinguishable from one another at the three levels of coverage. These constant estimates of WTP could be attributed to the low standard deviation of the WTP and the high statistical significance of the coverage and price variables.

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[21] The calculations for all log-likelihood ratio tests can be found in the appendix.

3.5.4 Aggregated Willingness to Pay

The next step in the CBA is the estimation of a benefits curve for expanding the protected area network in the Mixedwood Plains. For that purpose three logit models using the design variables with different specifications of coverage were estimated which can be seen below in table 3-12.

Table 3-12. Parameter and willingness to pay estimates using the design variables only and three different specifications for coverage[1]

	Specification A Linear Coverage	**Specification B Quadratic Coverage**	**Specification C Logarithmic Coverage**
Dependent variable: Probability of willing to pay a specified price level			
Intercept	0.80022* (17.396)	0.49189* (8.3949)	2.2114* (27.926)
Price	-0.0066894* (-37.102)	-0.0067502* (-37.241)	-0.0067374* (-37.227)
Coverage	6.3036* (13.789)	24.038* (11.077)	
Coverage*Coverage		-132.07* (-8.3676)	
Ln(Coverage)			0.31686* (15.731)
T2026	-0.046369 (-1.1283)	-0.045479 (-1.1053)	-0.045582 (-1.1085)
Obs.	11232	11232	11232
Log-likelihood	-6886.8	-6851.4	-6857.6
Log-likelihood (0)	-7743.0	-7743.0	-7743.0
P-value chisquare (d.f.=x)	0.00000 (d.f.=3)	0.00000 (d.f.=4)	0.00000 (d.f.=3)
McFadden R2	0.11058	0.11514	0.11435
% of right predictions	67.61%	67.43%	67.43%
Household WTP 1% Expansion	**$125.45**	**$102.99**	**$108.18**
Standard Deviation	**$4.56**	**$5.23**	**$5.10**
Household WTP 5% Expansion	**$163.34**	**$198.80**	**$183.99**
Standard Deviation	**$3.13**	**$5.39**	**$3.31**
Household WTP 12% Expansion	**$229.23**	**$215.09**	**$225.46**
Standard Deviation	**$5.38**	**$5.57**	**$4.78**

[1] t-statistics under parenthesis.

*Statistically significant at the 99% level

Specification A uses the standard linear definition of coverage; specification B adds a quadratic component for coverage; while specification C uses a logarithmic transformation for the coverage variable. The inclusion of the demographic and endogenous variables did not seem to skew the parameter estimates of the design variables. However, as the different specifications of coverage and its effect on the willingness to pay were of main interest to the study, the demographic and endogenous variables were left out of the analysis.

The price parameter remains constant at -0.0067 with a high degree of statistical significance as indicated by the large t-statistic. Echoing previous results the time variable remains not significant from zero for all three specifications. The different specifications of coverage affect the household WTP estimates with the WTP ranging approximately from \$103-\$125 for the 1%-, \$163-\$199 for the 5%-, and \$215-\$229 for the 12% expansion. The standard deviations however are still low indicating the low dispersion of the expected WTP estimates.

The benefits curve should estimate the aggregated welfare of the Ontario public at each level of coverage. The Treasury Board of Canada proposes a real discount factor of 8% when performing cost and benefit analysis which was used for discounting the WTP for each household over 5 years (Treasury Board of Canada Secretariat 2007). As can be seen in table 3-13, the number of dwellings in Ontario was 4,972,869 according to a Statistics Canada census in 2006. Simple multiplication using the number of dwellings in Ontario and the household WTP allowed for the estimation of aggregated WTP for protected areas in the Mixedwood Plains. Using the formula for the expected willingness to pay described at the end of chapter 2.2.4, the following WTP functions were drawn for the Mixedwood Plains using parameters from table 3-12. Due to the fact that time was not statistically significant from zero the expected willingness to pay was calculated with the time variable equal to zero. This is equivalent to the benefits curves being drawn for an expansion that gets completed in the year 2016.

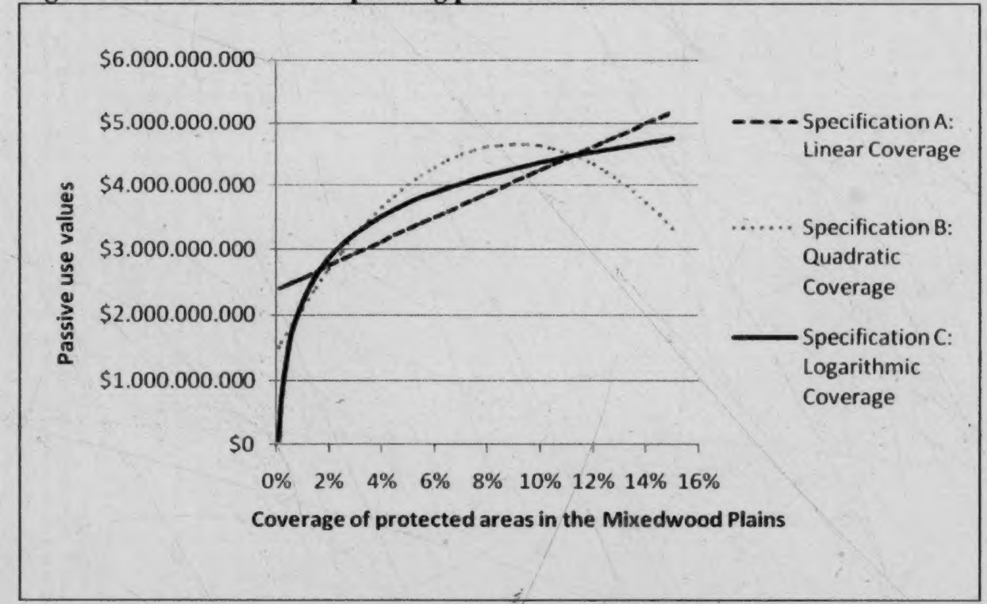
Table 3-13. Population Characteristics in Ontario 2006

Population	12,160,282
Dwellings	4,972,869

Source: Statistics Canada (2007) (Statistics Canada 2007)

Figure 3-4 below displays three different curves representing the benefits of protecting the natural environment in the Mixedwood Plains. The horizontal axis shows the level of coverage of protected areas in the Mixedwood Plains and the vertical axis the monetary passive use values or benefits at each level of coverage. The curves show how the benefits change from expanding protected areas from the 0.6% level of coverage in the status quo and up to a 15% level of coverage.

Figure 3-4. Benefits from expanding protected areas in the Mixedwood Plains



The benefits curves show that the public of Ontario is willing to pay between $2.1 to $2.6 billion for 1% level of coverage, $3.3 - $4.0 billion for a 5% coverage and $4.3-$4.6 billion for a 12% coverage depending on which model specification is used to estimate the benefits curve. The goodness-of-fit measures indicate that the non-linear specifications B and C are superior to linear specification A. Specifications B and C have a higher R^2 with only a slightly lower percentage of correct predictions than specification A. Specification B has a higher R^2 than specification C that could be due to the fact that specification B has one extra parameter over specification C. Their predictive power is virtually identical and although it is hard to choose the superior model, model C might be more appropriate.

The concave shape of the quadratic function which starts to curve down after the 9% level of coverage could be interpreted as being unrealistic and rejects respondent's behaviour of being willing to pay more for a 12% expansion relative to the 1% and 5% expansion. The linear curve also makes unreasonable assumptions that benefits will continue to increase indefinitely no matter what the level of coverage might be. The logarithmic function gives the most realistic representation of utility in the sense that benefits increase for each marginal increase in the level of coverage but at a decreasing rate which is consistent with the law of diminishing marginal utility. For these reasons the linear and quadratic specifications were discarded and the logarithmic curve was used instead for the cost and benefit analysis for ecodistrict 6E-12.

3.5.5 Willingness to Pay for Conserving Ecodistrict 6E-12

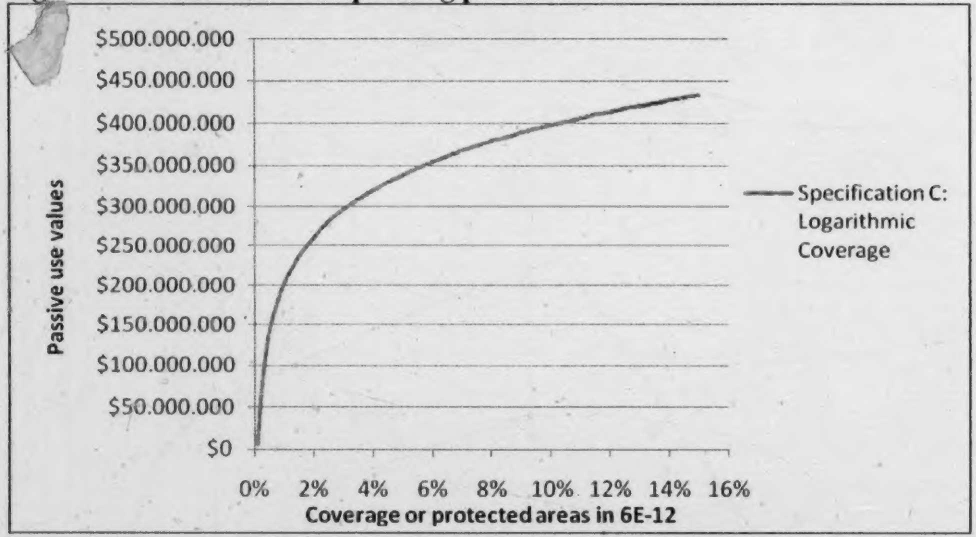
Table 3-14 shows that the total size of the Mixedwood Plains ecozone is almost 21 million acres while the size of ecodistrict 6E-12, a small region within the ecozone, is close to 1.9 million acres. Elementary calculations determine the size of 6E-12 to be approximately 9.12% of the total area of the Mixedwood Plains.

Table 3-14. Conversion factor for estimating the benefits from expanding protected areas in ecodistrict 6E-12

Size of the Mixedwood Plains:	20.998.071,21 acres
Size of 6E12:	1.914.646,94 acres
Size of 6E-12 as a ratio of the Mixedwood Plains	9,12%

Assuming that the Ontarian public WTP is equally spread across the Mixedwood Plains the size of 6E-12 as a ratio of the overall size of southern Ontario can be used as a conversion factor for the WTP for protected areas in ecodistrict 6E-12. Using such simple arithmetic the logarithmic WTP function was drawn for 6E-12 which can be seen in figure 3-5.

Figure 3-5. Benefits from expanding protected areas in ecodistrict 6E-12



The current coverage of protected areas within ecodistrict 6E-12 is 0.1%. The benefits curve was therefore drawn to cover and expansion from 0.1%-15% coverage of protected areas within the ecodistrict. Using this logarithmic benefits curve people were willing to pay approximately $202 million for a 1% expansion, $339 million for a 5% expansion and $414 million for a 12% expansion

3.5.6 Mixed Logit Model

Up to this point the analysis has been restricted to standard logit model estimation. One major drawback to the logit model is that preferences are estimated under the assumption of homogeneity which imposes the same preference structure on every respondent (Allison 2001). The mixed logit model assumes that parameters are drawn from a predefined random distribution allowing heterogeneous preferences to explain voting behaviour (Louviere et al.

2000). This form of estimation will also take into account that 8 observations were made per respondent instead of treating each observation independently in the model.

Estimating such a model would allow further exploration of heterogeneity in the design- and demographic variables and whether the assumption of homogeneous or heterogeneous preferences has a significant impact on welfare measures. In order to avoid complexities in the estimation of WTP the price parameter is often kept fixed in the literature. Otherwise issues of multidimensionality of WTP, difficulties with interpreting positive price coefficients and the problematic treatment of price parameters close to zero would make statistical analysis extremely cumbersome (Train 2001). Table 3-15 below shows mixed logit results for two models providing estimates of the design variables with logarithmic coverage in model 1 and a joint analysis of the demographic and design variables in model 2.

The constant in the standard logit model represents the utility associated with the proposed program without the effect of other program attributes. For this reason the constant was also made to be random as it is conceivable that the value of the constant is individual specific. In order to ease econometric estimation all random and continuous demographic variables were scaled to be within 0 and 1. The maximum value of each variable was chosen to represent the upper limit of the scale and all other values were computed to be a ratio thereof. The normal distribution was assumed for all parameters as other distributional assumptions, such as the log-normal distribution, resulted in lack of convergence of the maximum likelihood estimator.

The results in models 1 and 2 show that allowing parameters to be heterogeneous in nature did not greatly alter parameter signs or WTP estimates. Model 1 shows that despite the different parameter estimates for the design variables WTP estimates (calculated at the variable means) remained close to the welfare estimates calculated in the original logit model in table 3-12. Statistical significance of the design variables increased considerably as indicated by the t-statistics, except for the time variable that remained statistically non-significant.

Table 3-15. Mixed logit model estimation of the design and demographic variables using the logarithmic specification for coverage and assuming a normal distribution

Variable	**Mixed Logit Model 1**[1]	**Coefficient Std. Dev.**[1]	**Mixed Logit Model 2**[1]	**Coefficient Std. Dev.**[1]
Design variables:				
Price	-0.007662** (-54.711)		-0.007680** (-54.729)	
Intercept	2.475311** (37.977)	1.989438** (50.564)	2.139698** (20.224)	0.965322** (31.859)
Ln(Coverage)	0.344353** (-21.803)	0.372944** (38.055)	0.348975** (22.033)	0.358136** (36.759)
T2026	-0.047591 (-1.205)	0.074862* (1.932)	-0.046753 (-1.179)	0.195314** (4.945)
Demographic variables:				
Household income (scaled)			0.254385** (3.271)	1.187693** (27.690)
Male gender			-0.071431* (-1.853)	0.336558** (8.693)
Age of respondent (scaled)			0.522422** (4.396)	2.641525** (40.963)
Number of children in the household (scaled)			-0.824738** (-5.815)	1.752881** (10.537)
Resident of northern Ontario			-0.085084 (-1.216)	0.906906** (8.921)
Individuals	1404		1404	
Observations per respondent	8		8	
Log-likelihood	-5611.011		-5581.218	
Log-likelihood (0)	-6857.559		-6824.363	
P-value chisquare	0.000		0.000	
McFadden R2	0.181777		0.182162	
Number of random draws	100		100	
Distribution of rand.param.	Normal		Normal	
Household WTP 1% Expansion	**$112.99**		**$108.67**	
Household WTP 5% Expansion	**$185.33**		**$181.80**	
Household WTP 12% Expansion	**$224.68**		**$221.58**	

[1] t-statistics under parenthesis.

*Statistically significant at the 90% level

**Statistically significant at the 99% level.

Adding the demographic variables to the analysis in model 2 slightly lowered welfare measures compared to model 1. Parameter signs and statistical significance of demographic variables remained similar to those depicted in table 3-11 except for a slight drop in statistical significance for the gender variable. Males appear not significantly different from females in preferences at the 95% level but display a high degree of heterogeneity. There is also a high degree of heterogeneity in other demographic variables indicating that the effects of demographic characteristics are not fixed over respondents.

The standard deviations of the design variables have a high degree of statistical significance implying that heterogeneity in respondents' parameter preferences is significant. The three figures display an analysis of heterogeneous parameter preferences for the time variable, intercept and coverage with the negative portion of the distribution highlighted.

Figure 3-6. Heterogeneous preferences for the time variable, T2026, assuming a normal distribution

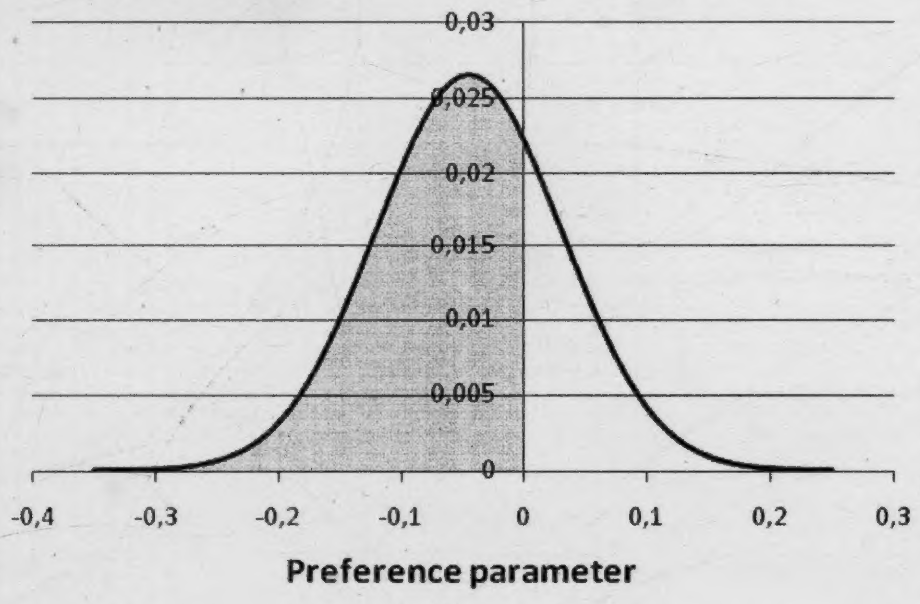


Figure 3-7. Heterogeneous preferences for the intercept assuming a normal distribution

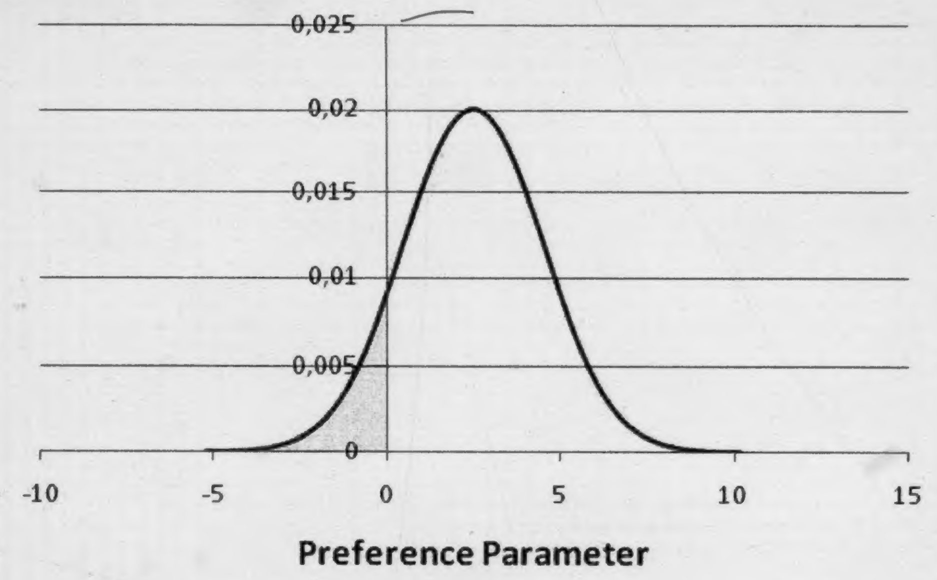
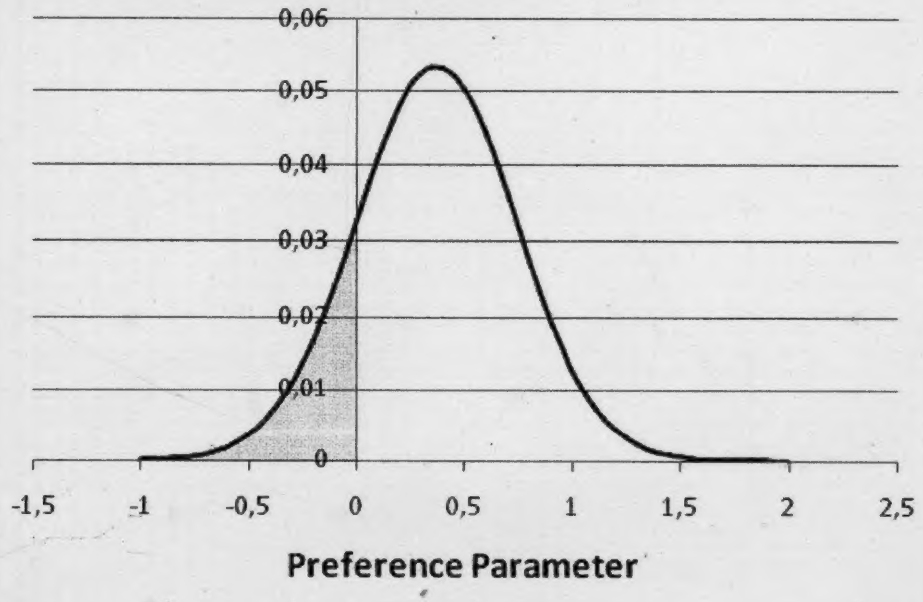


Figure 3-8. Heterogeneous preferences for the coverage variable, ln(Coverage), assuming a normal distribution



Although the standard deviation of the time variable was statistically significant, the mean of the distribution was not significant from zero. This might be interpreted as evidence for heterogeneous preferences for the time variable while the exact nature of those preferences remain elusive until the center of the distribution can be pinpointed. The result that 73.75% of the distribution is located on the negative side of zero implying the majority of respondents prefer the protected area expansion to happen sooner in 2016 rather than later in 2026, must therefore be interpreted with caution.

The intercept exhibited significant heterogeneity demonstrating the majority or 81.31% of respondents obtained positive utility from the proposed programs. Both the mean and standard deviation for the coverage variable were also statistically significant from zero. The minority or 17.79% of the distribution was on the negative side of zero indicating the majority of respondents obtained positive utility from expanding the coverage of protected areas in the Mixedwood Plains. This is consistent with the distribution of heterogeneity for the intercept which shows that a small minority or 10.69% of respondents received negative utility from the proposed programs.

The mixed logit model provided useful insights into heterogeneous preferences for the proposed program attributes that warrant further investigation for future research[22]. However, the results show that relaxing the homogeneity assumption of the standard logit model does not have a large impact on WTP measures or the positive or negative effects of parameters on the probability of choice. It is therefore safe to assume the results from the standard logit model are providing useful and meaningful estimates of the aggregate passive use values associated with a protected area expansion in the Mixedwood Plains.

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[22] An analysis of the mean shifts for the time variable using the demographic variables were inconclusive and did not provide an explanation for the lack of significance for the mean of the random time variable.

3.6 Cost Estimates

Costs were estimated using a hedonic price function employing land characteristics to predict acquisition costs of future land purchases in ecodistrict 6E-12. The following chapter describes the hedonic model results; the methodology adopted to plot the cost function for 6E-12; and the validity and application of the cost estimates.

3.6.1 Hedonic Model Results

Table 3-16 provides an overview of the parameter estimates from Vyn (2007) used for the cost curve analysis.

Table 3-16. Results of the OLS model for the Greenbelt effects on vacant land, cited from Vyn (2007)

Dependent variable: ln(sale price per acre) [a,b]

Variable	Coefficient	Std. Error	Variable	Coefficient	Std. Error
Greenbelt Variables			Location Variables		
PC	-0.4504***	0.1059	ln(GTA)	-0.2143***	0.0301
ORM	-0.2008	0.1378	ln(Town)	-0.0830***	0.0275
NE	0.0406	0.1884	Brant	-0.5076***	0.1077
PC intermediate	0.2512	0.1663	Bruce	0.0160	0.0645
ORM intermediate	0.0116	0.1529	Dufferin	0.1829**	0.0862
NE intermediate	0.0854	0.2540	Durham	-0.1699*	0.1009
PC post-GB	-0.2833	0.1948	Grey	-0.0601	0.0592
ORM post-GB	0.4747*	0.2492	Haldimand-Norfolk	-0.8171***	0.1079
NE post-GB	-0.7155*	0.3769	Halton	0.1182	0.1494
PC post-GB X ln(GTA)	0.1765***	0.0618	Hamilton	-0.8987***	0.1564
ORM post-GB X ln(GTA)	-0.1309	0.0884	Huron	0.1903**	0.0838
NE post-GB X ln(GTA)	0.3132***	0.0996	Kawartha Lakes	-0.3777***	0.0880
			Niagara	-0.9714***	0.1362
Land Quality Variables			Northumberland	-0.3692***	0.1034
ln(Lot size)	-0.4346***	0.0213	Oxford	0.1744**	0.0875
Class 1 land	0.6700***	0.0532	Peel	0.3570***	0.1273
Class 2 land	0.4031***	0.0467	Perth	0.4632***	0.0735
Wooded area	-0.2476***	0.0840	Peterborough	-0.1628*	0.0953
Organic Soil	-0.2565	0.2692	Simcoe	0.1397**	0.0590
ln(Heat units)	3.1834***	0.5334	Waterloo	0.3689***	0.1181
Orchard/vineyard	0.8136***	0.1573	York	0.4909***	0.1184
			Gravel Road	-0.0769	0.0649
Neighbourhood and Amenity Variables					
ln(Pop density)	0.2845***	0.0235	Other Variables		
Growth rate	0.0542***	0.0128	Month	0.0103***	0.0009
Water/sewer	0.0489*	0.0279	Speculative	1.7999***	0.1762
			Constant	-15.6608***	4.1694
Number of observations	1,935		R-squared	0.8319	

a Asterisks (*, **, ***) indicate that the coefficient is significantly different from zero at the 10%, 5% and 1% levels, respectively.

b To address the issue of heteroskedasticity, robust standard errors are generated.

The model uses multiple land characteristics to predict changes in the natural logarithm of sale price per acre. Most parameters were statistically significant at the 10%, 5% or 1% level and the R-squared was reasonably high indicating that the parameters were explaining 83.19% of the variation in the land prices.

Some variables were not available or referring to land characteristics or counties outside ecodistrict 6E-12. Table 3-17 gives an overview of the variables that were available for ecodistrict 6E-12. Four variables: "wooded area", "ln(Heat units)", "orchard/vineyard" and "Water/sewer", were added to the constant by multiplying their mean with their parameter estimate as seen in tables 2-7 and 3-16. All other variables not displayed in table 3-17 were set equal to zero for the analysis. These variables allowed sufficient variation in land characteristics to construct an estimated cost curve for acquiring additional protected areas in 6E-12.

Table 3-17. Variables available for the cost analysis for ecodistrict 6E-12

	Variable available	Added to the constant
Land Quality Variables		
ln(Lot size)	Yes	No
Class 1 land	Yes	No
Class 2 land	Yes	No
Wooded area	No	Yes
Organic Soil	Yes	No
ln(Heat units)	No	Yes
Orchard/vineyard	No	Yes
Neighbourhood and Amenity Variables		
ln(Pop density)	Yes	No
Growth rate	Yes	No
Water/sewer	No	Yes
Location Variables		
ln(GTA)	Yes	No
ln(Town)	Yes	No
Other Variables		
Constant	Yes	No

3.6.2 Cost Curve for Ecodistrict 6E-12

The hedonic study by Vyn (2007) uses a rich dataset with land sale prices representing over 50% of the Mixedwood Plains stretching west to east from Lake Huron to Peterborough and Northumberland counties. They used county specific dummies to adjust the constant to account for county specific characteristics that might affect land values. Ecodistrict 6E-12 is divided between three counties: the united counties of Stormont, Dundas and Glengarry; Prescott and Russell; and Ottawa. These three counties lay outside Vyn´s study area and therefore a county specific constant was simulated to account for a range of average prices per acre within the ecodistrict. For this purpose, three counties within the greenbelt study were chosen to represent the three counties within ecodistrict 6E-12. In order to capture the proximity to the greater metropolitan area of Ottawa and Montréal in Quebec, they were all chosen from counties close to Toronto city bearing closest resemblance to the specific counties within 6E-12. Table 3-18 displays the counties that achieved the closest match based on characteristics describing population level, population change, private dwellings, population density and land area.

Table 3-18. Comparison of Green Belt counties with the three counties present in 6E-12

Population and dwelling counts	**Ottawa**	**Durham**	**Stormont, Dundas & Glengarry**	**Peterborough**	**Prescott & Russell**	**Northumberland**
Population in 2006	1,130,761	561,258	110,399	133,080	80,184	80,963
Population in 2001	1,067,800	506,901	109,522	125,856	76,446	77,497
2001 to 2006 population change (%)	5.90%	10.70%	0.80%	5.70%	4.90%	4.50%
Total private dwellings	478,242	202,155	46,286	67,281	31,310	35,069
Private dwellings occupied by usual residents	449,031	194,672	44,263	53,561	30,068	31,539
Population density per square kilometre	197.8	222.4	33.4	35	40.1	42.5
Land area (square km)	5,716	2,523.2	3,306.86	3,805.7	2,001.18	1,902.1
Mean price/acre		$23,017		$5,539		$2,834
Median price/acre		$8,079		$1,878		$1,901
Adjacent to Toronto		Yes		Yes		Yes

The mean price/acre of each of these representative counties was used to serve as a proxy for the average price within the three counties of 6E-12. Table 3-19 below shows how the average price/acre for land within 6E-12 was calculated. Ontario Parks experts selected 28 parcels covering a total of 178,276 acres of potential purchases for expanding the protected area network within 6E-12. The ratio of the total size of these parcels within each county in 6E-12 served as a weight factor to calculate a weighted average of the price/acre within 6E-12. The cost curve results from the hedonic model were calibrated by adding to the constant a calibration factor that forced the average price per acre of the cost curve after all 28 parcels in 6E-12 had been purchased, to equal the proxy price of $6,280/acre. Additional cost curves were provided and calculated in a similar fashion for an upper bound of $10,000/acre and a lower bound of $2000/acre in addition to $4,000/acre and $8,000/acre curves. Chapter 3.6.3 provides a discussion of the validity of these cost curves.

Table 3-19. Weighted average acquisition price/acre and proportion of land protected for the three counties within ecodistrict 6E-12

Total size of potential protected areas in 6E-12: 178,276 acres

	Ottawa	Stormomt, Dundas & Glengarry	Prescott & Russell
Proxy for average price/acre	$23,017	$5,539	$2,834
Total size of potential protected areas within county (acres)	18,216	91,198	68,862
Total size of potential protected area parcels within county as a % of the total size of potential protected areas in 6E-12	10.22%	51.16%	38.63%
Weighted average acquisition price/acre	**$6,280**		

The expansion of the protected area network in 6E-12 was assumed to take place over the next 5, 10 or 20 years. The 5 year time frame is equivalent to investing the acquired funds from Ontario tax payers immediately in nature reserves as soon as they are collected, while the 10 and 20 year time frames represent the two different levels of the time attributes proposed in the valuation scenarios. The longer time frames therefore assume that the collected funds from the public of Ontario is invested in a trust fund and used for the sole purpose of expanding the protected area network over the next 10-20 years. When calculating the present value of the costs, the total acquisition costs for expanding protected areas in ecodistrict 6E-12 were assumed to be divided equally over the time frame.

The Treasury Board of Canada proposes a real discount factor of 8% when performing cost and benefit analysis (Treasury Board of Canada Secretariat 2007). This discount rate, however, does not take into account the changes in land prices over time. According to Farm Credit Canada (2007) the compounded average of increases in Ontario land prices 1998-2007 was 2.80%, which was used to adjust the discount factor. Subtracting this price trend from the discount factor yielded a net discount rate of 5.20% which was used to calculate the present value of the costs. Figures 9-11 below show the present value (PV) of the cost curves from expanding protected areas in ecodistrict 6E-12 for each of the three different time frames (5, 10 and 20 years). These are least cost curves as the 28 protected area parcels are assumed to be acquired in consecutive order of price/acre from the cheapest parcels to the most expensive.

Figure 3-9. Present value of the cost curves for expanding protected areas in 6E-12: Discounted over 5 years

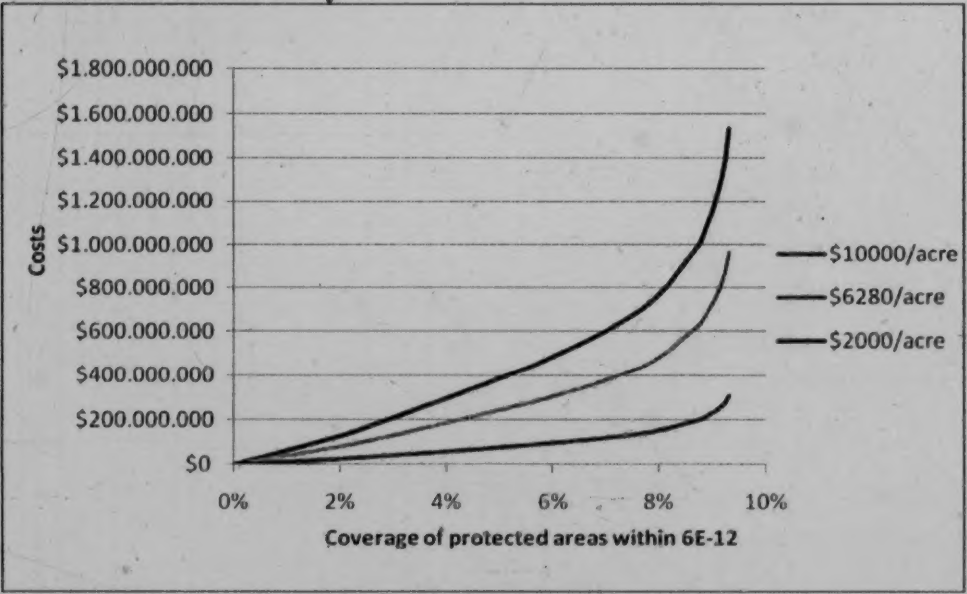


Figure 3-10. Present value of the cost curves for expanding protected areas in 6E-12: Discounted over 10 years

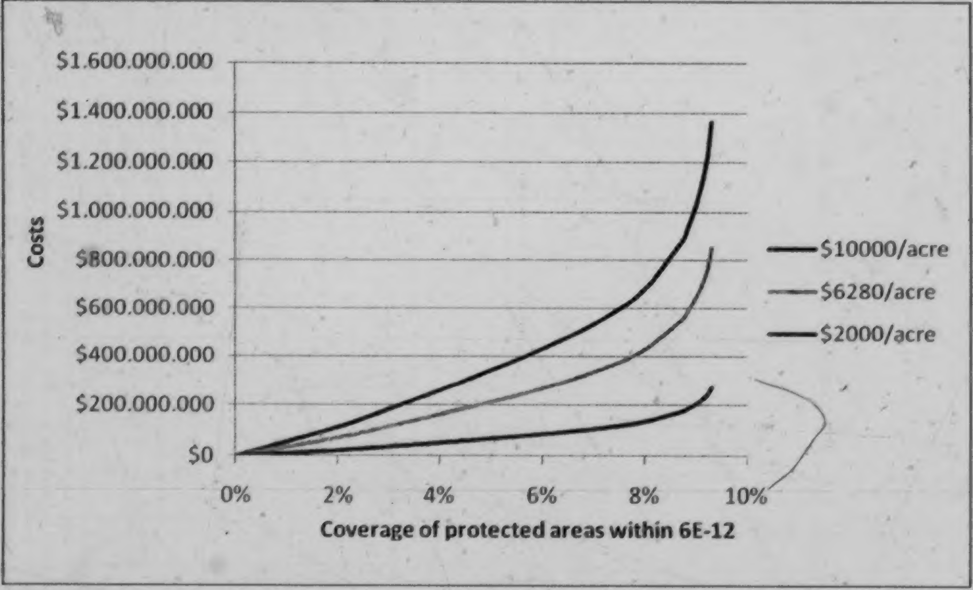
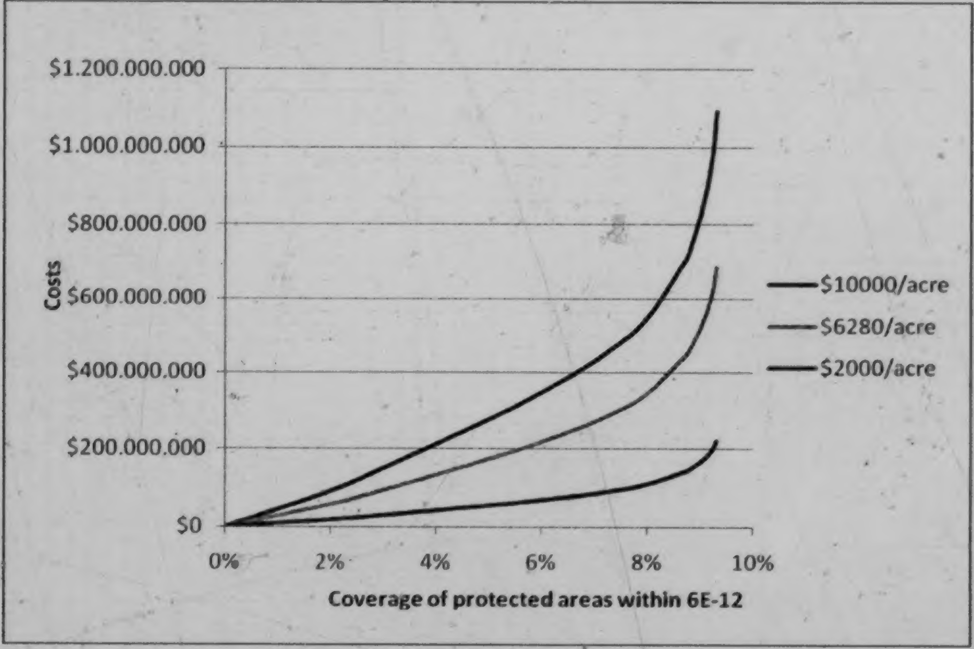


Figure 3-11. Present value of the cost curves for expanding protected areas in 6E-12: Discounted over 20 years



These three figures also demonstrate that discounting over a longer period of time has the effect of shifting the cost curves downwards reducing the weight of costs which will in turn increase the net benefits of expanding the protected areas. For this reason a sensitivity analysis must be performed on the cost curve assumptions to gauge their effect on final results. The following chapter will address the validity of the cost estimates and their usefulness for policy recommendation.

3.6.3 Validity of the Cost Curve Estimates

Ontario Parks in partnership with the Nature Conservancy of Canada has invested $21,881,617 in 42,165.5 acres of protected areas in the period 1996-2006. This roughly translates to an average acquisition price of $518.9/acre. However, this low average price/acre does not discredit the cost curve calculations for 6E-12 as these protected area parcels represent only a tiny portion of the Mixedwood Plains and only 80% of these parcels can be considered prime agricultural land (Ontario Parks 2006). Furthermore land prices have been on the increase in Canada over the last 10 years and have grown on average 2.8% per annum[23] (Farm Credit Canada 2007). The cost calculations in 6E-12 were based on vacant land in proximity to the metropolitan areas of Ottawa and Montreal, next to major roads and highways which should intuitively have an appreciative effect on property values[24].

The cost curves were drawn using a hedonic model based on 1,935 land property transactions from a large area within the Mixedwood Plains. The hedonic model was useful in allowing property values to vary, that is to appreciate or depreciate according to the level of certain land characteristics. In addition the hedonic model had county specific dummies that adjusted land values based on county specific characteristics that were not explained by other factors of the model. The hedonic model did not cover the three counties that made up ecodistrict 6E-12 and therefore no such county specific dummy was available for each of these three counties. To address this issue, a county specific dummy was calculated to adjust the land values within 6E-12 to be within a reasonable price range for land markets in the Mixedwood Plains. It is extremely probable that the characteristics that affect land prices in other parts of the Mixedwood Plains, e.g. location, distance to population centers, land quality, population density and growth have similar positive or negative effects in other parts of the Mixedwood Plains. However, the degree of this effect can be disputed for particular regions, e.g. how much land will depreciate in value when distance to major population centers increases, and therefore an upper- and lower bound was provided to assess the effect changes in costs might have on the optimal allocation of protected areas within 6E-12. Such sensitivity analysis on major assumptions is standard procedure when conducting cost and benefit analysis to elicit their effect on final results and recommendations (Boardman et al. 2006).

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[23] Appendix A calculates the price trend of farmland values in southern Ontario.

[24] In addition the partnership may have acquired the cheapest parcels first. In other words they may have acquired the low-hanging fruit in terms of available land parcels.

Table 3-20 reveals the results from an informal search through property listings maintained by the Ottawa Real Estate Board (2007) of actual land prices for vacant land in its natural state and not zoned for urban development. This type of land was selected as it was assumed that Ontario Parks desires land as close to its natural state as possible and which did not interfere with urban zoning policies. From the range of available properties a weighted average was calculated to represent average price/acre within each of the three counties within 6E-12.

Table 3-20. Price/acre for vacant land based on an informal search through property listings maintained by the Ottawa Real Estate Board for the three counties within ecodistrict 6E-12

	Ottawa	Stormomt, Dundas & Glengarry	Prescott & Russell
Listed weighted average price/acre	$8,265	$6,730	$2,634

The results in table 3-20 must be interpreted with caution as online property listings suffer from sample selection bias and cannot be guaranteed to represent desirable land for habitat conservation nor give a thorough picture of the total availability of land for sale. Furthermore these land parcels cannot reject or confirm the estimated price/acre for the 28 protected area parcels in 6E-12 as detailed land characteristics were not available for the property listings. However, these highly informal results indicate that the proxy price per acre in table 3-19 and the range of the sensitivity analysis ($2000/acre-$10000/acre) could encompass the property values in the three counties of 6E-12.

3.7 Costs and Benefits from Expanding Protected Areas in 6E-12

The cost and benefits curve for 6E-12 can have multiple implications for policy decision making. As can be seen in figure 2-1, when equated together the two curves can for example: (1) determine changes in public welfare from expanding the protected area network from the current situation; (2) identify where marginal benefits equal marginal costs (MB=MC) which in turn uncovers the level of protected area coverage that maximizes public welfare; and (3) locate the cut-off point where total benefits and total costs (TB=TC) are equal and further increases in the protected area network only serves to decrease public welfare as costs are then greater then benefits.

Figure 3-12. Present value of costs and benefits from expanding protected areas ecodistrict 6E-12: Costs discounted over 5 Years

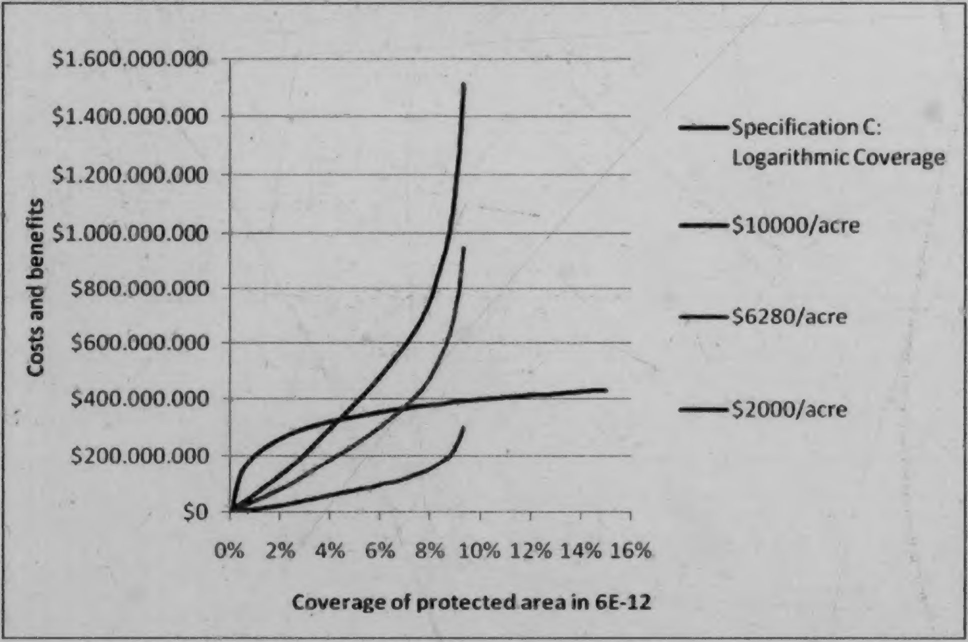


Figure 3-13. Present value of costs and benefits from expanding protected areas in ecodistrict 6E-12: Costs discounted over 10 Years

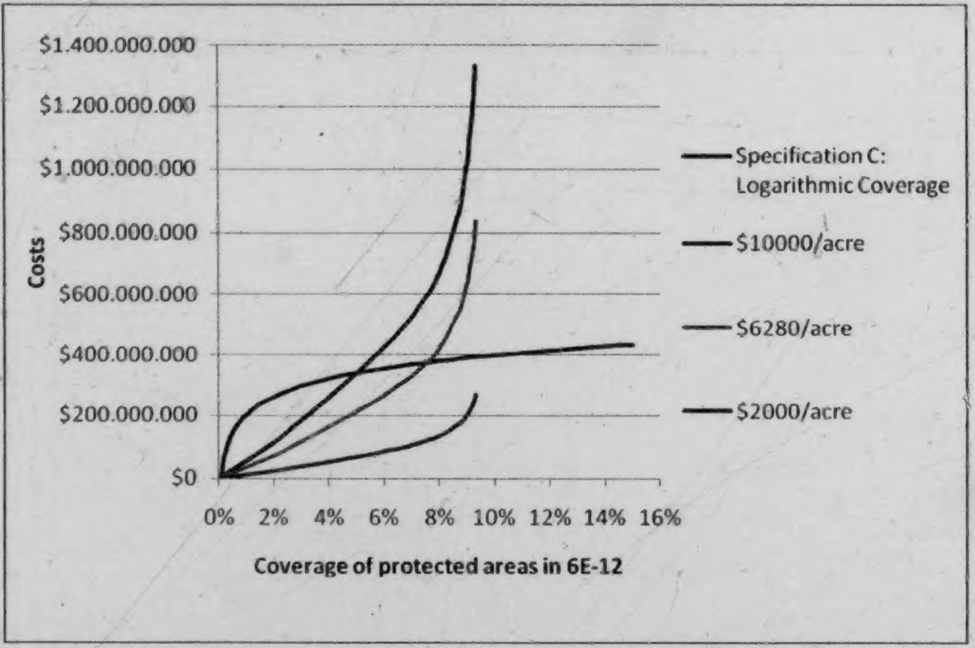
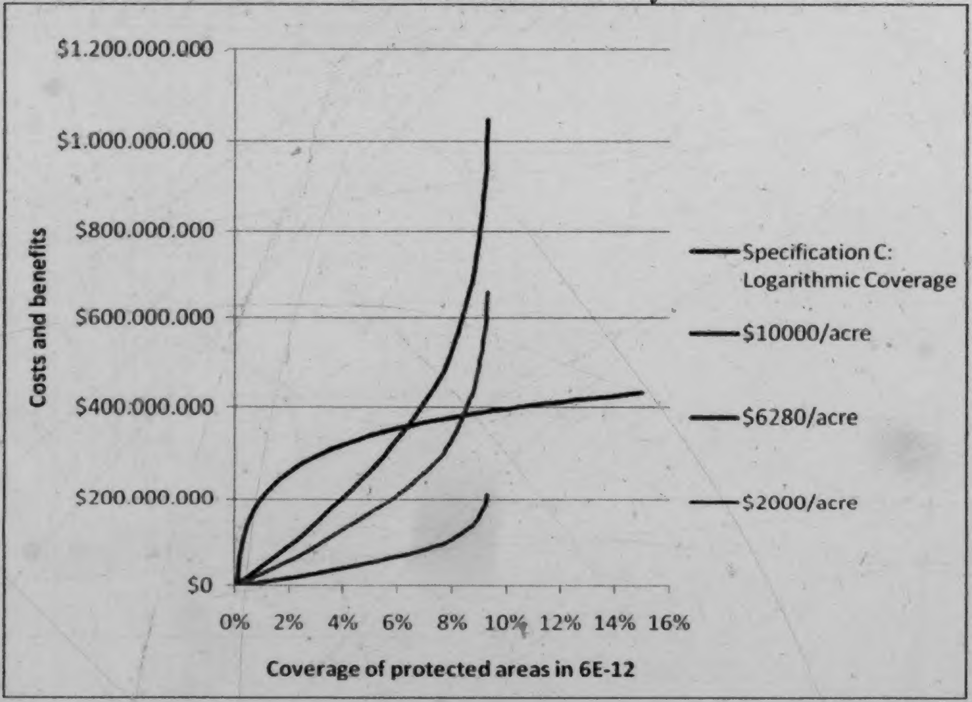


Figure 3-14. Present value of costs and benefits from expanding protected areas in ecodistrict 6E-12: Costs discounted over 20 years



Figures 12-14 display the benefits using the logarithmic benefits curve and costs from expanding protected areas in ecodistrict 6E-12 for three different discount periods; 5-, 10- and 20 years. The three graphs show that the time frame of the protected area expansion and therefore the discount period for the costs has a significant effect on the final outcome of the analysis. Increasing the discount period shifts the cost curves downwards which increases the optimal coverage level of protected areas in 6E-12 that maximizes social welfare.

Table 3-21 shows the level of coverage where marginal benefits equal marginal costs and the corresponding maximum net benefits for 6E-12 under the three different discount periods for various levels of costs. In the table net benefits are provided in millions of dollars above each optimal level of coverage. When net benefits are at their maximum level the optimal allocation has been reached where the public good provision is most valuable to the public. Table 3-21 also shows that the optimal allocation of protected areas is heavily dependent on the level of costs and the discount period which is dictated by the time frame of the protected area expansion. Depending on the discount period, for the $2,000/acre curve the optimal coverage of protected areas ranges from 4.38%-5.45%, 1.97%-2.53% for the $6,280/acre curve and 1.37%-1.79% for the $10,000/acre curve. The $4000/acre and $8000/acre curves are also provided to supply additional levels of sensitivity of the optimal level of coverage to costs.

Table 3-21. Optimal level of coverage and net benefits for protected areas in ecodistrict 6E-12

M= Million $		**Cost curves defined by different average cost levels**				
		$2,000/acre	**$4,000/acre**	**$6,280/acre**	**$8,000/acre**	**$10,000/acre**
Costs discounted 5 years	Logarithmic benefits	$263.6M 4.38%	$216.6M 2.73%	$183.4M 1.97%	$164.5M 1.64%	$146.3M 1.37%
Costs discounted 10 years	Logarithmic benefits	$271.1M 4.73%	$224.6M 3.22%	$192.4M 2.15%	$173.8M 1.79%	$156.1M 1.51%
Costs discounted 20 years	Logarithmic benefits	$285.0M 5.45%	$240.3M 3.46%	$208.7M 2.53%	$190.8M 2.12%	$173.7M 1.79%

% Shows the optimal level of protected area coverage in ecodistrict 6E-12
$ shows the maximum net benefits attainable at the optimal level of coverage
N/A Indicates a corner solution where the optimal level of coverage is equal to zero

Table 3-22 shows the cut-off level of protected area coverage where benefits and costs are equal and further increases in the level of coverage will only serve to decrease public welfare.

Table 3-22. Cut-off level for the percentage of protected area coverage in ecodistrict 6E-12 where costs and benefits are equal

		Cost curves defined by different average cost levels				
		$2,000/acre	**$4,000/acre**	**$6,280/acre**	**$8,000/acre**	**$10,000/acre**
Costs discounted 5 years	Logarithmic benefits	>9.3%	>9.3%	6.7%	5.5%	4.5%
Costs discounted 10 years	Logarithmic benefits	>9.3%	>9.3%	7.4%	6.1%	5.0%
Costs discounted 20 years	Logarithmic benefits	>9.3%	>9.3%	8.1%	7.3%	6.0%

Data were not available to draw the cost curve further than 9.31% and in the case of the lower two cost curves at $2000-$4000/acre the cost curves did not manage to cross the benefits curve. Without further data one can only assume that the cut-off point is somewhere in excess of the 9.31% coverage level.

These results demonstrate that in the case of the lowest two cost curves expansion can achieve coverage levels in excess of 9.3% for all three discount periods before costs become greater than benefits. For the $6,280/acre curve the cut-off point is between 6.8%-8.1% depending on the time frame, 5.5%-7.3% for the $8,000/acre and 4.5%-6.2% for the $10,000/acre cost curve. These results illustrate that the efficiency of the protected area expansion will depend on the resourcefulness of Ontario Parks experts in making clever land purchases that achieve representation targets while minimizing their costs. The lower the costs of the protected area expansion, the greater level of optimal coverage that maximizes public welfare in Ontario or the maximum level of coverage achievable before costs are greater than benefits.

4 Summary and Conclusions

This study provides a practical example how two different methods of environmental evaluation, the hedonic property model and methods of stated preferences, can be analysed jointly to estimate the social optimal level of protected area coverage in the Mixedwood Plains. The following chapter will be divided into a summary of major findings, policy implications and a discussion of areas for future research.

4.1 Major Findings and Policy Implications

The results from the stated preference survey and the hedonic property model provide useful insights into the optimal allocation of protected areas in the Mixedwood Plains that maximize public welfare in Ontario. The benefits were designed to be conservative and provide a lower bound for the public willingness to pay (WTP) for additional protected areas in the Mixedwood Plains. To that end, responses to WTP questions were analysed after considering uncertain responses as no´s and removing yea-sayers. The scope test confirmed the validity and credibility of the benefit curve estimates indicating that participants took the votes seriously, understood the scenarios and behaved in an economically rational manner when providing their WTP for protected areas.

Using the logarithmic benefits curve, the WTP per household once a year for five years ranged from $108.18 for a 1% expansion, $183.99 for a 5% expansion and $225.46 for a 12% expansion with standard deviations ranging from $3.31-$5.10. These figures translate to an aggregated present value of willingness to pay ranging from $2.2 billion for the 1%-, $3.7 billion for the 5%- and $4.5 billion for the 12% expansion in the Mixedwood Plains region. The low standard deviations of the WTP reflect the high statistical significance of the coverage and price variables indicating that choices made by respondents were generally consistent over the level of price and coverage in the valuation scenarios.

Using the mixed logit approach relaxes the homogeneity assumption and takes into account that there were 8 observations per respondent. The mixed logit model revealed significant heterogeneity in design- and demographic variables when assuming a normal distribution. When the distribution of the coverage and intercept parameters were examined they revealed that only a small minority of the distribution was on the negative side of zero indicating the majority of respondents derived positive utility from the proposed programs. This econometric framework did not significantly alter the WTP measures for a protected area expansion. It is therefore safe to assume the results from the standard logit model provide useful and meaningful estimates of the passive use values associated with a protected area expansion in the Mixedwood Plains.

Cost curves were estimated using a robust model estimated by Vyn (2007) employing a rich dataset of property transactions from a large area covering over 50% of the Mixedwood Plains. These cost parameters provided an estimate of the non-linear shape of the cost curves which were plotted for expanding protected areas in ecodistrict 6E-12. Ontario Parks experts selected 28 potential protected area parcels employing standard procedures of C-plan and Gap-analysis, and variables from Vyn's model were linked to the 28 parcels using Geographic Information System (GIS). When the parcels were sequenced in order of price/acre smooth cost curves representing the minimum acquisition costs at each level of coverage were generated for 6E-12.

The cost and benefits curve for 6E-12 had multiple implications for policy decision making. When equated together the two curves showed that depending on the costs of protected area acquisition and the time frame of the expansion, the net benefits were maximized by increasing protected area coverage in 6E-12 to 1.37%-5.45% providing maximum net benefits ranging from $146.3 million - $285.0 million. The results also showed that depending on the costs of expansion, protected area coverage could be increased from 4.5% to somewhere in excess of 9.3%[25] in 6E-12 before costs become greater than benefits. The final welfare effects however depended on the time frame of the expansion and the acquisition price of additional land to the protected area network. The longer the time frame needed to reach protected area targets, the longer the discount period which ultimately results in a lower present value of costs.

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[25] The 28 parcels selected by Ontario Parks experts covered 9.31% of ecodistrict 6E-12. Data was unavailable to estimate costs further than 9.31%.

The cost and benefit curves had several policy implications for whether further expansion of the protected area network would increase public welfare. Results showed that the ultimate allocation of protected areas in the Mixedwood Plains depends on whether policy makers are interested in maximizing net public benefits from protected area allocation or expanding protected areas until benefits no longer exceed the costs. The results also illustrate that the efficiency of the protected area expansion will depend on the resourcefulness of Ontario Parks experts in making clever land purchases that achieve representation targets while minimizing costs. Lower acquisition costs allow for a greater level of protected area coverage that maximizes public welfare in Ontario.

4.2 Limitations of the Study

Several limitations affected the final results of this study. Budget and time constraints limited the research to the basic costs and benefits associated with a protected area expansion in the Mixedwood Plains. Only acquisition expenses for land were considered for the costs while passive use values were considered for the benefit side. Data restrictions, the hedonic method, and hypothetical methods of stated preferences all suffer from specific issues that can affect final results. These issues will now be examined in further detail.

Other forms of costs such as maintenance, building of park infrastructure and administration costs were left out of the analysis. Furthermore, costs for future protected area acquisition were only estimated for a small region within the Mixedwood Plains. This limited the policy implications for the joint estimation of the costs and benefits to approximately 10% of the Mixedwood Plains. Furthermore, data for the cost model represented over 50% of the Mixedwood Plains but not the specific region of ecodistrict 6E-12 which the cost analysis was limited to. GIS data were not available in 6E-12 for the full range of variables used in Vyn's model and therefore several variables had to be included in an updated constant for the cost estimates. After making use of proxies representing the average price/acre within the three counties that comprise 6E-12, sensitivity analysis was necessary to determine the effect of a range of cost curves on the optimal level of protected area coverage. The parameter estimates from the hedonic model were therefore more useful in estimating the shape of the cost curve rather than estimating specific curves representing the acquisition price of land in 6E-12.

Several limitations affect the validity and reliability of the hedonic pricing method which served as the basis of the cost estimation. The method assumes all agents have full and accurate information about land characteristics and have homogeneous preferences for these attributes. Variables can be mutually correlated or in those cases were consumers can influence the level of certain attribute characteristics, endogenous to the model. These issues can skew final results and reduce the validity of parameter estimates (Grafton et al. 2004). The cost curves therefore form a useful guideline for the expected acquisition price of protected areas but are by no means an absolute prediction of what final acquisition costs might be.

Benefit estimates were limited to passive use values only and ignored other sources of benefits such as use values, option values and improvements in ecological services. Budget constraints limited the number of focus groups and pre-tests conducted for the survey design and additional focus groups sessions and pre-tests would have helped to optimize the bid design to better capture the shape of the WTP function. The total benefits were assumed to be spread evenly across the Mixedwood Plains and preferences for specific types of habitat or regions were not investigated. Data were also limited to 1,629 individuals which prevented a more detailed analysis of regional differences in preferences such as testing whether WTP was significantly different between northern- versus southern Ontario.

Stated preference methods are hypothetical in nature and the discrete choice based question format combined with a tax based payment vehicle chosen for the analysis is considered to be incentive compatible for respondents to report their true WTP (Freeman III 2003). Despite an incentive compatible experimental design, hypothetical bias, anchoring, yea-saying and uncertainty remain important issues that can potentially skew final results. Proven measures such as cheap talk, debriefing questions and treating uncertain responses as "no" were taken to mitigate hypothetical bias and address issues with uncertainty. The resulting conservative estimates of WTP must therefore be considered a lower bound for the benefits of expanding the protected area network in the Mixedwood Plains but not the ultimate representation of benefits.

4.3 Areas for Future Research

Due to budget and time constraints many aspects of the protected area expansion remain to be investigated. Only the basic costs and benefits were the subject of this study and future research could consider additional benefits and costs to gain a broader picture of all relevant impacts for expanding protected areas in the Mixedwood Plains such as increased revenues from tourism, benefits from biodiversity and ecological services. Only three different specifications for the coverage variable were analysed (linear, quadratic and logarithmic) and future studies might discover more efficient functional forms for the benefits curve. Hypothetical bias remains an issue with stated preference techniques and proven techniques such as cheap talk, debriefing questions, randomization of the order of questions, and treating uncertain responses as "no" were employed to insure the accuracy, robustness and reliability of final WTP results. Additional research would address the effectiveness of these techniques and examine how closely final results reflect actual WTP in a public referendum.

Future sensitivity analysis on the benefit side could also take into account additional forms of econometric modeling including a more detailed analysis of random effects and random parameters techniques. When the design and demographic variables were made random in the mixed logit models considerable heterogeneity was present in respondent's preferences for the proposed programs. Further analysis could examine the nature of the heterogeneity in closer detail, the correlation between random parameters and consider additional forms of random parameter distributions and their effect on parameter estimates.

This study measured the willingness to pay for protected areas in the Mixedwood Plains irrelevant of location, type of habitat and specific benefits to endangered ecosystems, plants and animals. The passive use values are therefore representing the total coverage of protected areas in the Mixedwood Plains but not its individual components. Further research might include identifying critical regions of natural habitat and estimating passive use values associated with them in order to prioritize the order of protected area acquisition within the Mixedwood Plains. Additional considerations could include regional preferences for a protected area expansion and a larger sample to effectively measure possible differences in preferences between residents of northern and southern Ontario.

The cost curves were estimated for ecodistrict 6E-12 only using data on property transactions that represented other regions within the Mixedwood Plains. To develop a more accurate cost curve for ecodistrict 6E-12 data should be gathered for property transactions that represent the region in question. To gain a profound understanding of the implications of the protected area expansion in southern Ontario as a whole, costs and benefit curves representing different regions within the Mixedwood Plains should be estimated to get more accurate cost- and welfare approximations for different segments within the Mixedwood Plains. Additional sensitivity analysis can also be performed on major assumptions such as the effects of different price trends for land over time, the use of different proxies for land prices in the three counties that comprise 6E-12 and the inclusion of additional explanatory variables to estimate land prices such as distance to roads, railways and environmental amenities.

Despite these limitations, the results have practical policy implications for the future of protected areas in southern Ontario. They provide policy makers with the tools to realize the welfare effects changes in protected area coverage might have and identify the optimal level of coverage that maximizes public welfare within the Mixedwood Plains.

Appendix A – Calculations

I. Cost Estimates for the Bid Vector

These calculations were made in September 2006 to have some reference point for the potential cost of increasing protected areas in southern Ontario. Demographic information was based on available census data from Stat Canada (2001).

Since 1996, Ontario Parks has been acquiring land for extending the protected area network. Using census data from Stat Canada, the average acquisition price of $1,176.47/hectare and assuming no increases in land prices over time the following cost estimates per household in Ontario were determined to be:

1%	$26 / household
5%	$131 / household
12%	$315 / household

The following calculations were made to have some reference point for the potential cost of increasing protected areas in southern Ontario. The average price per hectare of acquired land to expand the protected are network in the Mixedwood Plains 1996-2006 was used to estimate the average cost for each household in Ontario.

Current population of Ontario: 12.686.952 people

Average size/household in 2001: 2.7 people/household => 4.698.871 households in Ontario

Total land acquired for protection in Ontario 1996-2006: 17,000 hectares

Total cost of acquired areas in 2006 $: $20 million => $1,176.47/hectare on average

Total size of the Mixedwood Plains: 10,500,000 hectares

1%	105,000 hectares
5%	525,000 hectares
12%	1,260,000 hectares

The relationship between coverage and cost of acquisition is most likely non-linear. The results from the hedonic model were not available at the time and therefore this relationship was assumed to be linear for the calculations. The following calculations estimate the costs of acquiring the 1%, 5% and 12% of the Mixedwood Plains, using the average cost of $1176.5/hectare acquiring protected land in southern Ontario 1996-2006 and assuming no increase in land prices (17,000 hectares were acquired for 20 million CAD over 10 years).

Linear cost estimates:

1% 105.000 ha x ($1176.5/hectare) = $123,51 m
5% 525.000 ha x ($1176.5/hectare) = $617.65 m
12% 1.260.000 ha x ($1176.5/hectare) = $1.482,35 m

Linear cost/household assuming public funds are used to fund 100% of the expansion:

1% $123,51 m / 4.7 m = $26,28 / household
5% $617,65 m / 4.7 m = $131 / household
12% $1.482,35 m / 4.7 m = $315,4 / household

To calculate the tax increase per year for 5 years a 5% interest rate was assumed which was close to the US federal reserve rate in September 2006.

Linear cost for 5 years / household:

1% = 5,32 ≈ $5/year for 5 years
5% = 26,52 ≈ $25/year for 5 years
12% = 63,87 ≈ $65/year for 5 years

These cost projections provided a form of reference point when deciding the attribute levels for the cost of expanding the protected area network in southern Ontario.

II. Price Trend for Land Values

The following table for price changes of agricultural land in Ontario was based on data from Farm Credit Canada (2007).

Table A-1. Increases in agricultural land prices in Ontario 1998-2007

July 1998	July 1999	July 2000	July 2001	July 2002	July 2003	July 2004	July 2005	July 2006	July 2007
3.428%	1.455%	4.220%	1.354%	3.581%	3.021%	3.378%	2.413%	2.970%	2.211%

Compounded average 1998-2007
= (1.03428*1.01455*…*1.0297*1.02211)^(1/10) – 1
= 1.317962.8%^(1/10) – 1 = 2.8%

Appendix B – Statistical Tests

I. Two Sided t-Test for Regional Difference in NEP

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S_{\bar{X}_1 - \bar{X}_2}}$$

Where $S_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{(n_1 - 1) * s_1^2 + (n_2 - 1) * s_2^2}{n_1 + n_2 - 2} * \left(\frac{1}{n_1 + n_2}\right)}$ and $\bar{X}_1$ and $\bar{X}_2$ are the means of the two different samples that are to be compared.

$H_0 = \bar{X}_1 - \bar{X}_2 = a$

$H_1 \neq a$

If t > than the critical level of the t-distribution the null hypothesis is rejected.

II. Kolmogorov-Smirnov Test

One-Sample Kolmogorov-Smirnov Test performed using functions in SPSS.

Table A-2. Kolmogorov-Smirnov test for the normality of the NEP scale

		NEP
N		13,032
Normal Parameters(a,b)	Mean	56.12
	Std. Deviation	9.166
Most Extreme Differences	Absolute	0.052
	Positive	0.028
	Negative	-0.052
Kolmogorov-Smirnov Z		5.965
Asymp. Sig. (2-tailed)		0.000

a Test distribution is Normal.
b Calculated from data.

The test could not reject the null hypothesis that the distribution of the NEP scale was normal for respondents in the survey.

III. Log-likelihood ratio tests for model specification

Table A-3. Log-likelihood ratio tests for model specification

	Model 1 vs. Model 2	Model 2 vs. Model 3	Model 1 vs. Model 3
Ls: restricted	-6886.8	-6850.5	-6886.8
Lg: unrestricted	-6850.5	-6621.5	-6621.5
Degrees of freedom	5	3	8
Likelihood Ratio Test=2*$\log_e$(Lg/Ls)	72.6	458	530.6
Chi-square test statistic at the 1% significance level	15.09	11.34	20.09
Null hypothesis	Parameter restrictions apply		

Appendix C – Experimental Design Code from SAS

The following code was used to divide the full factorial of 24 choice sets into three blocks that ensured statistical design efficiency:

```
title 'Ontario Experimental Design';
 %Mktruns (4 3 2);
 %mktex(4 3 2, n=24, seed=18);
 %mktblock(data=randomized, nblocks=3, out=WORK.DESIGN, seed=17);
 title 'Evaluate the Experimental Design';
 %choiceff(data=WORK.DESIGN, model=class(x1-x3), nsets=8, flags=x1-x3,
 beta=zero, init=WORK.DESIGN, initvars=x1-x3, seed=9, intiter=0);
```

Selected output:

```
                Evaluate the Experimental Design
                  Design           1
                  Choice Sets        8
                  Alternatives       3
                  D-Efficiency    1.113959
                  D-Error       0.897699

Obs  Design  Efficiency Index  Set   Prob     n  x1  x2  x3  Block  Run
 1     1     1.11396      1     1   0.33333   1   1   3   2    1     1
 2     1     1.11396      2     1   0.33333   2   1   2   2    1     2
 3     1     1.11396      3     1   0.33333   3   2   1   1    1     3
 4     1     1.11396      4     2   0.33333   4   3   1   1    1     4
 5     1     1.11396      5     2   0.33333   5   2   3   1    1     5
 6     1     1.11396      6     2   0.33333   6   4   1   2    1     6
 7     1     1.11396      7     3   0.33333   7   3   2   1    1     7
 8     1     1.11396      8     3   0.33333   8   4   3   2    1     8
 9     1     1.11396      9     3   0.33333   9   3   2   2    2     1
10     1     1.11396     10     4   0.33333  10   1   3   1    2     2
11     1     1.11396     11     4   0.33333  11   2   1   2    2     3
12     1     1.11396     12     4   0.33333  12   4   3   1    2     4
13     1     1.11396     13     5   0.33333  13   3   1   2    2     5
14     1     1.11396     14     5   0.33333  14   1   2   1    2     6
15     1     1.11396     15     5   0.33333  15   2   2   2    2     7
16     1     1.11396     16     6   0.33333  16   4   1   1    2     8
17     1     1.11396     17     6   0.33333  17   3   3   2    3     1
18     1     1.11396     18     6   0.33333  18   2   2   1    3     2
19     1     1.11396     19     7   0.33333  19   1   1   1    3     3
20     1     1.11396     20     7   0.33333  20   4   2   1    3     4
21     1     1.11396     21     7   0.33333  21   4   2   2    3     5
22     1     1.11396     22     8   0.33333  22   3   3   1    3     6
23     1     1.11396     23     8   0.33333  23   1   1   2    3     7
24     1     1.11396     24     8   0.33333  24   2   3   2    3     8
```

Appendix D – Formulas for cost and benefit curves in 6E-12

I. Benefits Curve Formula

Benefit curve were approximated using the trend line function in Excel. Below are formulas for the three aggregated benefit curves and the logarithmic benefits curve used for ecodistrict 6E-12. X represents the level of protected area coverage in percentages. The trend line was successful in approximating the shape of the benefit curve with an R^2 of 100%.

Logarithmic benefit curve (LBC) for 6E-12:

LBC(X) = \$85,161,776.88*LN(X)+\$594,353,195.07

$R^2 = 100\%$

II. Cost Curve Formulas

The cost curves were also approximated using the trend line function in excel. The 28 parcels in 6E-12 were sequenced in order of cost based on price/acre. This allowed for the construction of a smooth cost curve that could be approximated using the trend line function in excel. There was a sharp increase in price/acre after the 8.1% level of coverage was reached and therefore the cost curve was divided into two segments that were approximated with two separate trend lines for coverage below and above the 8.1% coverage. Only the trend line below 8.1% was used for the calculations as the optimal level of coverage was always below 8.1% and the highest level of coverage where the cost and benefit curves crossed was at 8.1%. Below these formulas can be found in tables A-4 to A-6 for each level of costs discounted for 5, 10 and 20 years, where X represents the level of coverage of protected areas in percentages. All trend line approximated the shape of the cost curves very well with an R^2 of 100%.

Table A-4. Cost curve formulas: Costs discounted for 5 years

Price/acre	Formula for coverage up to 8.1%	R^2
$2,000/acre	$11,723,792,216*X^2+$916,445,134*X+$1,771,500	100%
$4,000/acre	$23,447,584,257*X^2+$1,832,890,255*X+$3,542,999	100%
$6,280/acre	$36,812,707,189*X^2+$2,877,637,693*X+$5,562,509	100%
$8,000/acre	$46,895,171,168*X^2+$3,665,780,717*X+$7,085,999	100%
$10,000/acre	$58,618,960,155*X^2+$4,582,225,599*X+$8,857,498	100%

Table A-5. Cost curve formulas: Costs discounted for 10 years

Price/acre	Formula for coverage up to 8.1%	R2
$2,000/acre	$11,176,870,002*X^2+$761,075,938*X+$2,027,857	100%
$4,000/acre	$20,822,427,938*X^2+$1,627,682,615*X+$3,146,330	100%
$6,280/acre	$32,691,211,779*X^2+$2,555,461,698*X+$4,939,739	100%
$8,000/acre	$41,644,858,233*X^2+$3,255,365,413*X+$6,292,661	100%
$10,000/acre	$52,056,069,412*X^2+$4,069,206,503*X+$7,865,826	100%

Table A-6. Cost curve formulas: Costs discounted for 20 years

Price/acre	Formula for coverage up to 8.1%	R2
$2,000/acre	$8,340,969,269*X^2+$652,010,933*X+$1,260,345	100%
$4,000/acre	$16,681,938,414*X^2+$1,304,021,856*X+$2,520,690	100%
$6,280/acre	$26,190,643,242*X^2+$2,047,314,309*X+$3,957,484	100%
$8,000/acre	$33,363,878,715*X^2+$2,608,043,860*X+$5,041,381	100%
$10,000/acre	$41,704,845,687*X^2+$3,260,054,614*X+$6,301,725	100%

Appendix E – Environmental attitudes

Three questions were designed to probe respondent´s environmental awareness and sentiments towards the environment. Participants were asked to declare if they were members of an environmental organization; whether they had visited a protected area in southern Ontario; and finally their environmental sentiments were gauged using the well known New Ecological Paradigm scale. Each question will now be examined in further detail:

I. Membership in an Environmental Organization

As can be seen in table A-7, using the full sample of 1,629 respondents, 6.14% stated in question 5 that they were members in an environmental organization while the ratio dropped to 5.69% after yea-sayers were removed.

Table A-7. Ratio of respondents that were members of an environmental organization

	All respondents N=1629	Yea-sayers removed N=1406
Member of an environmental organization	6.14%	5.69%

This could be an indication that the degree of yea-saying was more predominant amongst members than non-members. Table A-8 reveals that these members had a 15% higher probability of voting yes to a proposed program than other participants. The results were calculated with uncertain responses considered as no´s for both the full sample of 13,032 observations and the smaller sample of 11,248 observations where yea-sayers had been removed. In the full sample 71.3% of members in environmental organizations voted yes to any proposed program compared to 56.7% of other participants. Removing the yea-sayers did not change this result or reduce the 15% gap between the two types of respondent. A variable describing membership in environmental organizations was therefore included in the econometric analysis to determine the statistical significance of this seemingly higher willingness to pay for protected areas.

Table A-8. Voting behaviour of members in environmental organizations versus other participants

	Full sample		Yea-sayers removed	
Individual characteristics	**Voting Yes**	**Total**	**Voting Yes**	**Total**
Members in environmental organizations	570 (71.3%)	800	436 (68.1%)	640
Other participants	6934 (56.7%)	12,232	5680 (53.2%)	10,608
All Participants	7504 (57.6%)	13,032	6116 (54.4%)	11,248

II. Visits to Protected Areas in Southern Ontario

861 or approximately 55.5% of respondents stated in question 6 that they had visited a protected area in southern Ontario. Figure A-1 below shows the range of all activities these visitors participated in while figure A-2 depicts their primary activity within their full range of activities. When examining the range of primary activity, hiking was chosen to be the most popular form of recreation by 46.9% of respondents while 24.6% chose camping as the most important activity. 10.5% of respondents engaged in wildlife watching, 4.8% fishing while the remainder of available primary activities ranged between 0.1%-3.7%. While only 1.2% of respondents indicated their primary activity was hunting, figure A-1 shows that 12% of participants engaged in some form of hunting during their visits.

Figure A-1. All activities of visitors to protected areas in southern Ontario

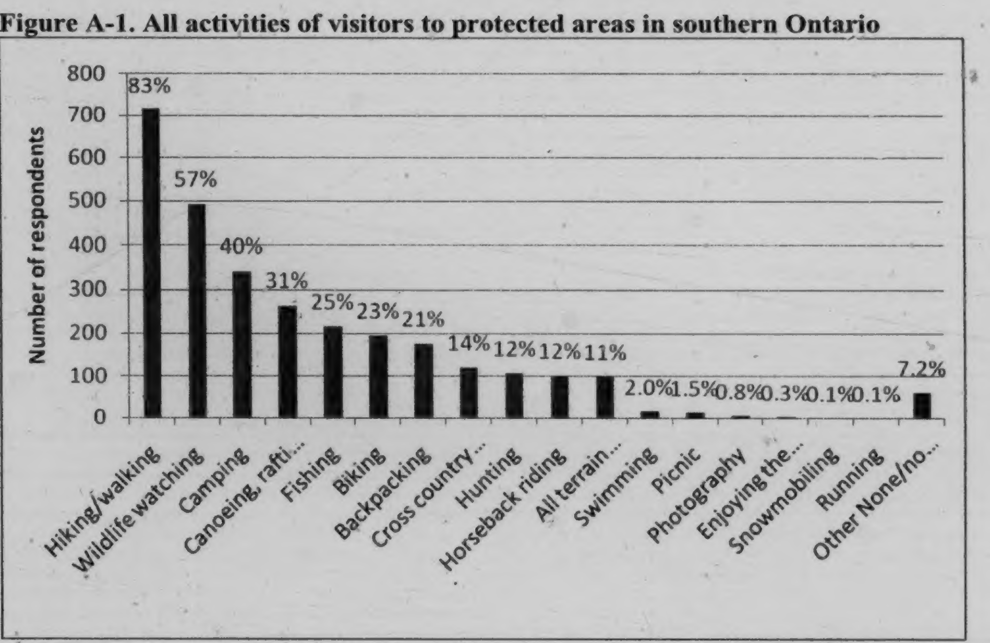

Figure A-2. Primary activity of visitors to protected areas in southern Ontario

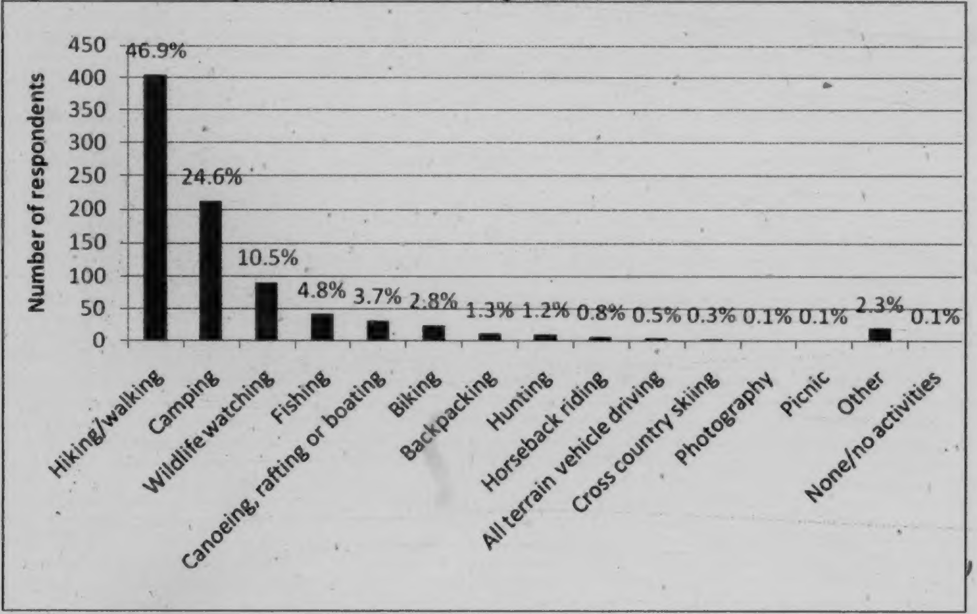

Figure A-3 below displays the ratio of respondents reporting how much time had elapsed since their last visit to a protected area in southern Ontario. The chart shows that 47% of these visits occurred within the last 12 months, 17%

within1-2 years, 12% within 2-3 years while over 24% paid such a visit 3 or more years ago.

Figure A-3. Ratio of respondents showing the elapsed time since their last visit to a protected area in southern Ontario

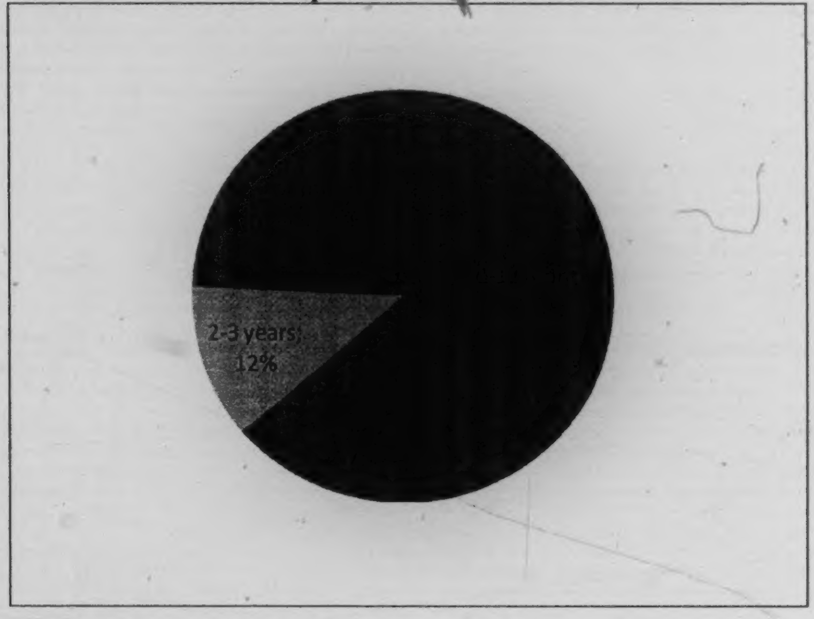

Table A-9. Voting behaviour of visitors to protected areas in southern Ontario versus other participants

	Full sample		Yea-sayers removed	
Individual characteristics	**Voting Yes**	**Total**	**Voting Yes**	**Total**
Visited a protected area in southern Ontario	4166 (60.5%)	6,888	3373 (57.2%)	5,896
Other participants	3338 (54.3%)	6,144	2743 (51.3%)	5,352
All Participants	7504 (57.6%)	13,032	6116 (54.4%)	11,248

Table A-9 shows that such visitors had an approximately 6% higher probability of voting yes to a proposed program than other participants. Removing yea-sayers slightly reduced but did not eliminate the gap in the probability of voting yes between the two groups of respondents. This variable was therefore included in the econometric analysis to capture any effects such visits to protected areas might have on respondent's willingness to pay for expanding these areas.

III. New Ecological Paradigm

The New Ecological Paradigm (NEP) scale has been frequently used to measure people´s general attitudes towards the environment. This scale is a revised version of the previous New Environmental Paradigm scale which consisted of 12 questions. The revised scale is based on 15 questions with a score of 1-5 points given for each question and is considered an improvement over the previous scale. The odd numbered questions have a reversed coding providing a respondent with 5 points for strongly agreeing and 1 point for strongly disagreeing while the even numbered questions are coded as shown below (Dunlap et al. 2000). This set of questions generates a scale from 15-75 where a lower score than the 45 indicates a low concern for the environment while a higher score exhibits pro-environmental sentiments. The full scale is provided at the end of this section. Using this scale, the average participant in the survey exhibited pro-environmental sentiments with an average score of 56.12 and standard deviation of 9.1 points as depicted in table A-10. It is interesting to note that the two sided t-test showed that males had a statistically significant lower average NEP score than females which might suggest that females have a higher degree of environmental sentiments than males.

Table A-10. NEP scores comparing males and females with and without yea-sayers

	Full sample		**Yea-sayers removed**	
	Mean NEP	Std. Deviation	Mean NEP	Std. Deviation
Males	54.83	9.5	54.03	9.4
Females	57.40	8.6	56.88	8.5
All respondents	56.12	9.2	55.47	9.1

Figure A-4 below shows the range of NEP scores for the full sample of respondents. The horizontal axis represents the NEP score and is divided into 60 equal intervals between 15-75, while the vertical axis indicates the number of respondents that exhibited the appropriate score. The Kolmogorov-Smirnov test confirms the shape of the distribution is normal at the 95% significance level. As can be seen below in table A-11 the NEP score and standard deviation are within the range of NEP scores estimated in a recent study on environmental attitudes using a population of Canadians residents in or near Banff and Kootenay national parks (McFarlane et al. 2006).

Figure A-4. New Ecological Paradigm score for the Ontario sample

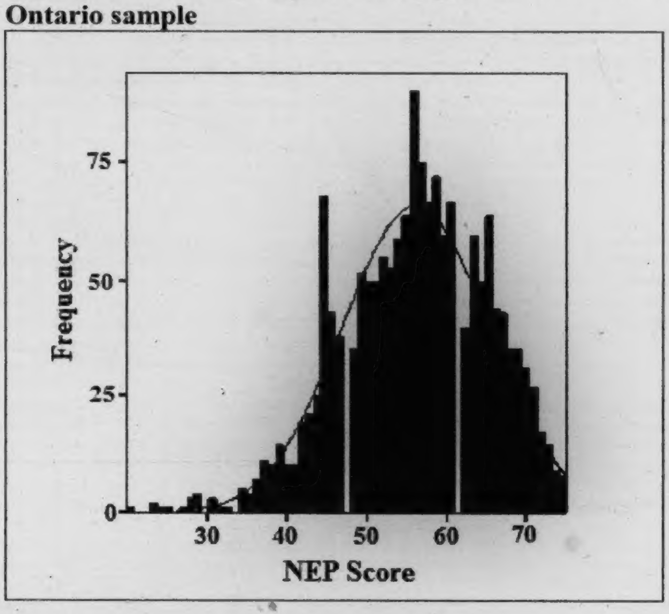

Table A-11. Comparison of Canadian NEP scores

Population	Number of respondents	NEP score	Standard Deviation	Is NEP score equal to Ontario NEP?*
Columbia Valley**	635	55.7	9.6	Yes
Bow Valley**	625	58.1	9.0	No
Calgary**	629	55.0	9.0	No
Ontario	1629	56.1	9.2	

* The two sided t-test was used to test statistical difference between the two sample means using the null hypothesis that the population means are identical at the 5% significance level.

** NEP scores based on results from (McFarlane et al. 2006)

Q39. Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you STRONGLY AGREE, MILDLY AGREE, are UNSURE, MILDLY DISAGREE, or STRONGLY DISAGREE with it.

POSSIBLE CONCERNS	**STRONGLY AGREE**	**MILDY AGREE**	**UNSURE**	**MILDLY DISAGREE**	**STRONGLY DISAGREE**
1. We are approaching the limit of the number of people the earth can support	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
2. Humans have the right to modify the natural environment to suit their needs	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
3. When humans interfere with nature it often produces disastrous consequences.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
4. Human ingenuity will insure that we do NOT make the earth unlivable	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
5. Humans are severely abusing the environment	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
6. The earth has plenty of natural resources if we just learn how to develop them	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
7. Plants and animals have as much right as humans to exist	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
9. Despite our special abilities humans are still subject to the laws of nature	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
11. The earth is like a spaceship with very limited room and resources	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
12. Humans were meant to rule over the rest of nature	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
13. The balance of nature is very delicate and easily upset	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
14. Humans will eventually learn enough about how nature works to be able to control it	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
15. If things continue on their present course, we will soon experience a major ecological catastrophe	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

The NEP score was useful for the econometric analysis to help explain voting behaviour as a larger NEP score indicates greater environmental sentiments which should be reflected in a higher WTP for protected areas in southern Ontario. When compared to the NEP score for the Ontario public, only the NEP score for Columbia valley was not statistically different at the 5% confidence level. Unfortunately, without further analysis and a cross check with a sample representing the Canadian population no final conclusions can be made about whether the NEP score for Ontario is higher, lower or similar to other regions of Canada. However, the NEP score for Ontario was normally distributed and bounded by the scores measured by McFarlane et al. (2006) and could therefore be an indication that the Ontario sample was not characterized by greater environmental sentiments than experienced in other parts of Canada. Although the following insight would require further research, this could mean that the sample used to estimate the WTP for expanding protected areas in the Mixedwood Plains was not biased by environmental sentiments.

Appendix F – The Survey[26]

The Future of Protected Areas In Southern Ontario

Survey

UNIVERSITY OF ALBERTA
QUAECUMQUE VERA

ONTARIO
PARKS

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[26] The survey format was adjusted to accommodate thesis format specifications. Furthermore this title page was only used for the paper based copies in the focus groups but not the internet based survey in order to reduce the „warm glow" effect such pictures might have on respondent's preferences for protected areas.

The Ontario Ministry of Natural Resources is responsible for protecting the natural environment in Ontario. We are seeking your opinion how much public funds should be invested in provincial parks protecting the natural environment in southern Ontario. Your feedback is important for protected areas to be managed in a way that is acceptable to the public of Ontario.

Thank you for volunteering your time to complete this survey. Please try to answer all the questions. It should take no longer than 20-25 minutes.

All information you provide is strictly confidential. Your name or any personal information will never appear with your answers. Only a summary of the results will be made public.

Your feedback is important and we appreciate your help with this project.

To contact the researchers:

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Q1. Consider the following list of current issues facing Ontarians today. For each issue, please rate the effort we should be spending compared to what is currently done in Ontario. [ALTERNATE ORDER]

Government Program in Ontario	**Do a lot less**	**Do less**	**Do about the same**	**Do more**	**Do a lot more**
Improving roads and highways					
Supporting the arts					
Improving education					
Encouraging economic growth					
Reducing crime					
Increasing job opportunities in rural communities					
Protecting the natural environment					
Lowering taxes					
Improving health care					

THIS PAGE INTRODUCES THE CONCEPT OF BIODIVERSITY

Biodiversity describes:

- The variety and abundance of all living organisms on Earth (plants, mammals, fish, birds, insects, etc.).
- The diversity of natural communities, ecosystems[27] and landscapes in which living organisms occur.

Some benefits that biodiversity provides for society are listed below:

ECOLOGIAL BENEFITS

- Producing breathable air.
- Providing and replenishing soil for growing trees and other plants.
- Supplying drinkable water by recycling water in watersheds.

ENVIRONMENTAL STABILITY

- Moderating climate shifts.
- Increased durability of wildlife and plants to survive changes in environmental conditions.
- Preventing soil erosion and floods.

SUPPORTING THE ECONOMY

- Producing building materials.
- Producing food from farming, hunting and fishing.
- Providing opportunities for tourism and nature recreation.

MEDICINE

- Natural resources provide 70% of medicine today.
- Ensuring a wide range of life forms from which new drugs may be found.

---

[27] Ecosystem: This is a self sufficient system of living organisms and their interaction with the environment, which supplies them with all the necessary elements for their survival such as water, air, food and shelter.

BIODIVERSITY IN CANADA AND ONTARIO

- The two maps below use species richness to estimate biodiversity in Canada and Ontario.
- Species richness is the number of wild animals and plants including birds, mammals, reptiles, amphibians, rare & endemic[28] plants living in a given land area.
- The colour coding represents species richness. The colours range from deep blue, which mean low number of species, to deep red which means a high number of species.
- The comparison shows that southern Ontario contains the highest biodiversity (estimated by species richness) in Canada.

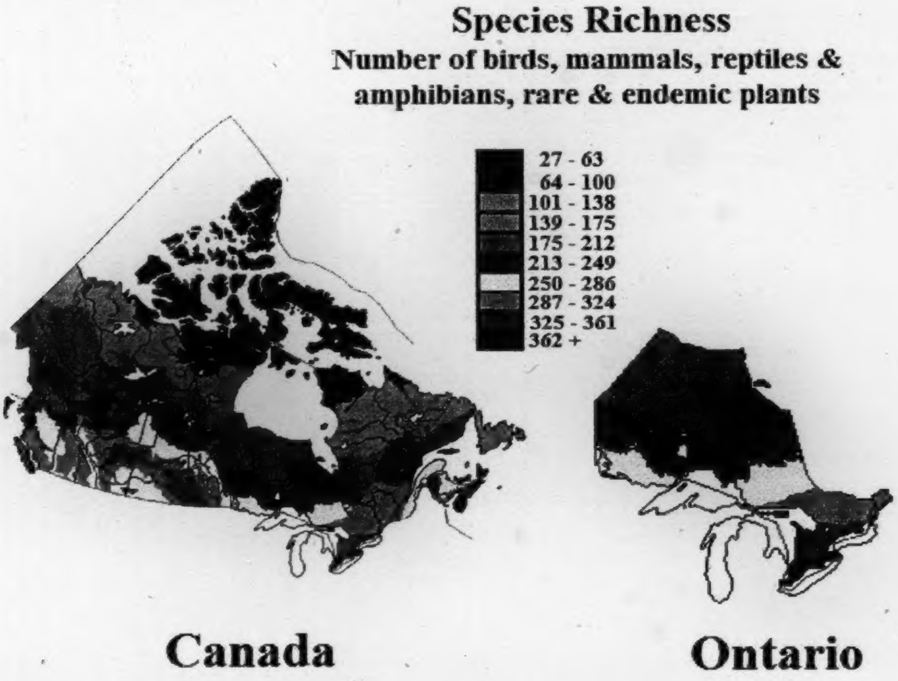
Species Richness
Number of birds, mammals, reptiles & amphibians, rare & endemic plants
27 - 63
64 - 100
101 - 138
139 - 175
175 - 212
213 - 249
250 - 286
287 - 324
325 - 361
362 +
Canada
Ontario

Figure 1. Species richness in Canada and Ontario

Map Sources: Conservation Blueprints and the Nature Conservancy of Canada

---

[28] **Endemic:** Describes a species of animal or plant that is unique to the area and not found anywhere else in the world.

Q2. Before taking this survey, were you aware that most of Ontario's animal and plant species are located in southern Ontario?

Please select one response only

- ○ Yes
- ○ No

THE MIXEDWOOD PLAINS OF SOUTHERN ONTARIO

- Various natural habitats[29] with diverse vegetation, evergreen and hardwood forests, wetlands, alvars[30] and tall-grass prairies.

- Diverse concentration of animal and plant species including the largest variety of fish, amphibians and reptile species in Canada.

- 10% of original forest cover remains - urban expansion, roads and clearing of land for agriculture has reduced forest cover.

- Ontario's largest concentration of plant and animal species at risk from disappearing from the province.

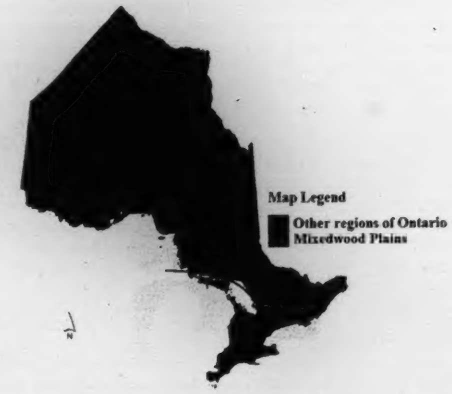

Figure 2: The Mixedwood Plains of southern Ontario

Map Source: Ontario Parks

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[29] **Natural habitat** describes a natural location with specific conditions, including an appropriate climate and available food and shelter, that are essential for certain species of wildlife and plants to survive.

[30] **Alvars** is a rare natural habitat, only found on limestone bedrock with little or no soil. Spring floods and summer drought create harsh conditions for a unique ecosystem of plants and animals.

ECONOMIC IMPORTANCE OF HUMAN ACTIVITY IN THE MIXEDWOOD PLAINS

As the two maps below show, human activity is concentrated in the Mixedwood Plains of southern Ontario. There are more people and agriculture in southern Ontario than in other parts of the province.

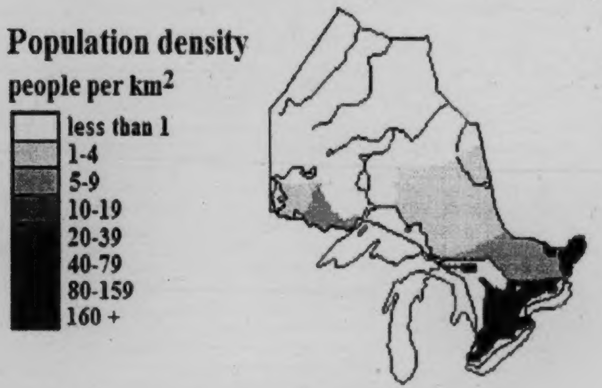
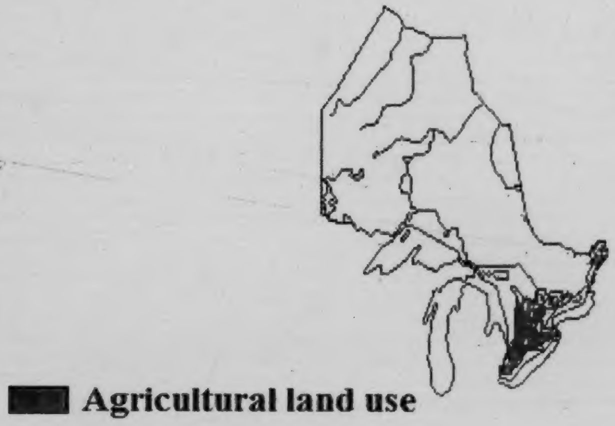


Figure 3. Population Density in Ontario

- The Mixedwood Plains contain the highest human population density in Ontario.
- The Mixedwood Plains is one of the most economically prosperous areas in Canada.
- Close access to markets of the eastern United States encourages economic prosperity.
- Major industries in southern Ontario include: Tourism, manufacturing, financial services, food, beverages and agriculture.



- Agriculture in Ontario takes place mostly in the Mixedwood Plains.
- Rich, fertile soils, mild climate and abundant rainfall make the Mixedwood Plains the most agriculturally productive zone in Canada.
- Over 56,000 farms in Ontario, account for almost one-quarter of all farm revenue in Canada.

Figure 4. Agricultural land use in Ontario

Map Source: Conservation Blueprints and the Nature Conservancy of Canada

Q3. Before taking this survey, were you aware that most of Ontario's population is located in southern Ontario?

Please select one response only.

- ○ Yes
- ○ No

Q4 How much do you think the following items affect the natural environment in the Mixedwood Plains of southern Ontario. For each item, please select the response that best reflects your opinion by checking the appropriate box. [ALTERNATE ORDER]

Items potentially affecting the natural environment in the Mixedwood Plains of southern Ontario	Significant adverse effect	Moderate adverse effect	Slight adverse effect	No negative or positive effects	Positive effects
Air pollution					
Water pollution					
Agricultural activities					
Poor management of natural resources					
Urban development					
Hunting/fishing of wild animals					
Drainage of wetlands and rivers					
Species introduced by people (e.g., baitfish) that do not belong within established ecosystems[31]					
Harvesting of trees and plants					
Climate change					

---

[31] Ecosystem: This is a self sufficient system of living organisms and their interaction with the environment, which supplies them with all the necessary elements for their survival such as water, air, food and shelter.

PROTECTED AREAS IN THE MIXEDWOOD PLAINS

- Protected areas put limits on human development within its borders to maintain natural ecological processes[32] and healthy populations of wild animal and plant species.
- Protected areas provide educational and outdoor recreational opportunities (paddling, hiking, camping, limited hunting, etc.).
- The protected area network in the Mixedwood Plains is much smaller than the network in northern Ontario.
- 630 km^2 or approximately **0.6%** of the Mixedwood Plains are now protected land.
- The map below shows the percentage of protected areas across Ontario. The lighter shade of green represents land with almost no protected areas and the darker shade represents land with more protected areas.

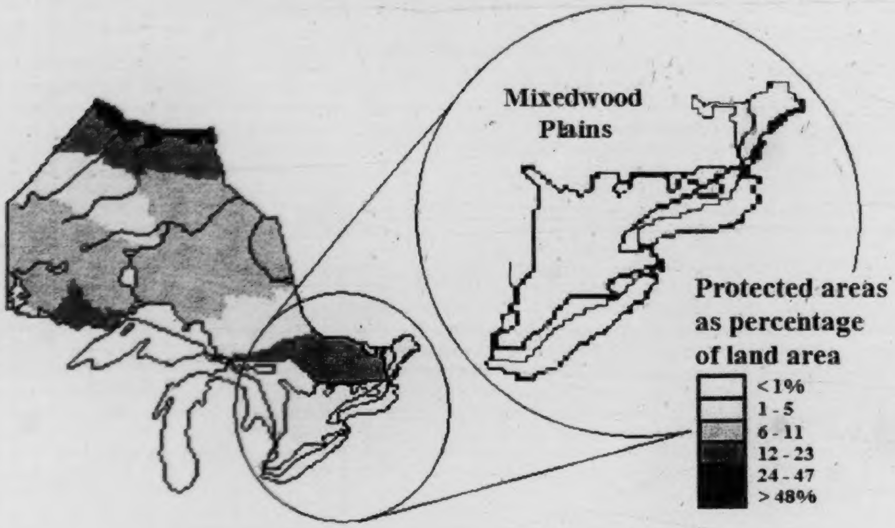


Figure 5. Protected areas across Ontario

Source: Conservation Blueprints and the Nature Conservancy of Canada

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[32] **Ecological processes:** E.g. processes that support healthy populations of wild plants and animals, recycle the air we breathe and filter the water we drink.

CONSERVING THE MIXEDWOOD PLAINS

- Ontario Parks invests public funds to acquire new protected areas in partnership with private non-profit conservation organizations.
- Since 90% of land in southern Ontario is privately owned, most additions to the protected area network come from private landowners.

The Ontario Parks partnership has three main methods of acquiring properties for conservation purposes:

- **Direct purchase:** Land acquired from private land owners based on a willing buyer and seller agreements at the appraised market value.
- **Donations:** Land donated for conservation purposes by private landowners.
- **Conservation easements:** A binding legal agreement imposing restrictions on land use to conserve the natural environment. Private land owner keeps full property rights and enjoys tax incentives.

Q6. Have you ever visited a protected area in southern Ontario?

- ○ Yes
- ○ No

If yes, ask the following TWO QUESTIONS before moving to the next page.

Q7. Approximately how long ago was your last visit to a protected area in southern Ontario?

Please select one choice only

- ○ Within the last 12 months
- ○ 1- less than 2 years
- ○ 2- less than 3 years
- ○ 3 or more years

Q8. What kind of activities did you participate in during your visit? After selecting the general activity/activities, of those selected please choose one primary activity you engaged in during your visit.

	General activity Please select all that apply.	**Primary activity** Please select one choice only.
Camping	☐	☐
Backpacking	☐	☐
Hiking	☐	☐
Biking	☐	☐
Cross country skiing	☐	☐
Wildlife watching	☐	☐
Horseback riding	☐	☐
Hunting	☐	☐
Fishing	☐	☐
Canoeing, rafting or boating	☐	☐
All terrain vehicle driving (ATVing)	☐	☐
Other (please specify)	☐	☐

POSSIBLE BENEFITS OF INCREASING PROTECTED AREAS

Q10. Below are some POSSIBLE BENEFITS of increasing the provincial protected area network in the Mixedwood Plains. In your opinion, how important do you think each of these benefits are?

For each statement, please mark one box only.

Possible Benefits	Not Important	Slightly Important	Very Important	Extremely Important
Availability of places for people to pursue outdoor recreation activities (for example, backpacking, canoeing, hunting, fishing, hiking, etc.)	1 ☐	2 ☐	3 ☐	4 ☐
Natural habitat[33] to protect wild animals and plants from human development	1 ☐	2 ☐	3 ☐	4 ☐
Stimulation of local economies through tourism	1 ☐	2 ☐	3 ☐	4 ☐
Availability of places to help maintain ecological processes (for example, natural processes that support healthy populations of wild plants and animals, recycle the air we breathe, filter the water we drink, etc.)	1 ☐	2 ☐	3 ☐	4 ☐
Enhancement of educational (for example, teach children about animals and plants or provide university students with research opportunities)	1 ☐	2 ☐	3 ☐	4 ☐

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[33] **Natural habitat** describes a natural location with specific conditions, including an appropriate climate and available food and shelter, that are essential for certain species of wildlife and plants to survive.

POSSIBLE CONCERNS OF INCREASING PROTECTED AREAS

Q11. Below are some POSSIBLE CONCERNS from increasing the provincial protected area network in the Mixedwood Plains. In your opinion, how concerned are you about the following issues?

For each statement, please mark one box only.

Possible Concerns	**Not at all Concerned**	**Slightly Concerned**	**Very Concerned**	**Extremely Concerned**
Restrictions placed on land development within protected areas (e.g. new roads, power lines, agriculture, forestry, mining, etc.)	1 ☐	2 ☐	3 ☐	4 ☐
Limits placed on urban development	1 ☐	2 ☐	3 ☐	4 ☐
Slower growth in the Ontario economy	1 ☐	2 ☐	3 ☐	4 ☐
Limits on certain outdoor recreation activities (for example, motor vehicle driving, hunting fishing, camping, hiking, etc.)	1 ☐	2 ☐	3 ☐	4 ☐
Government costs of acquiring protected areas reduces public funding that can be spent elsewhere	1 ☐	2 ☐	3 ☐	4 ☐

THE FUTURE OF PROTECTED AREAS IN THE MIXEDWOOD PLAINS

- We want to know how much effort you believe should be spent on conserving the natural environment in the Mixedwood Plains.

- In the next section, you will be asked to vote eight times on the future amount of protected areas in southern Ontario.

- For each vote, you will be asked to choose between two different alternatives:
  1. Current situation: Maintaining the existing amount of protected land in the Mixedwood Plains
  2. Proposed program: Increasing the amount of protected land within the Mixedwood Plains.

Under each of the eight votes, the proposed program as well as the current situation will be described by three characteristics:

1. Protected area targets.
2. Year when protected area target is reached
3. Annual investment of public funds.

The next page describes each of the three characteristics in further detail.

1. Protected area targets

- To achieve adequate natural habitat representation in the Mixedwood Plains a protected area coverage target may be set by the Ontario Ministry of Natural Resources.
- The targets can range from **1%-12% (1,050 km^2 – 12,600 km^2)** of the total area of land in the Mixedwood Plains being protected.

2. Year when protected area target is reached

- The year when the protected area target is reached indicates the time taken to reach the protected areas target. This time frame can range from 10-20 years.
- Time to complete the proposed protected area expansion will depend on the availability of suitable land and the amount of available funds for land acquisition.

3. Annual investments of public funds

- Under each vote the proposed program will carry a price tag
- The price tag represents your household's annual share of the investment in protected areas by the Ontario Parks partnership over the next five years.
- Your household's share of the annual investment will be paid through a one time increase in your household taxes that remains for the next 5 years, 2007-2011.
- The collected funds will be used for the sole purpose of funding a protected area expansion in the Mixedwood Plains.

THE RELATIVE SIZE OF PROTECTED AREAS

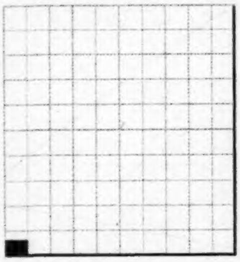
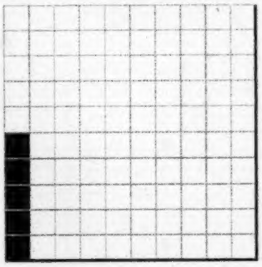
Pictures will be used to give you an idea how large a proportion of the Mixedwood Plains is currently being protected and how large in comparison the proposed protected area expansion will be.

- Each grid lined box represents the total land area (105,000 km^2 approx.) in the Mixedwood Plains:

= 105,000 km^2

- The green squares represent protected land within the Mixedwood Plains placing restrictions on human activity.
- The white squares represent normal land that is not protected in the Mixedwood Plains.

Example:

Protected area targets ■ **Protected land** □ **Normal land**	**0.6% (630 km^2)** of the Mixedwood Plains protected 	**5% (5,250 km^2 approx.)** of the Mixedwood Plains protected 

When considering the votes please keep in mind:

Some people might choose to vote to keep the current situation because they think:

- It is too much money to be spent for the size and timing of the protected area expansion
- There is currently sufficient coverage of habitats in the existing protected areas network in southern Ontario
- There are other places, including other environmental protection options, where my money would be better spent

Other people might choose one of the proposed program options because they think:

- The improvement in the protected areas network is worth the money
- Biodiversity and wildlife habitats need more protection
- This is a good use of money compared to other things government money could be spent on

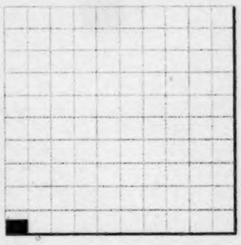
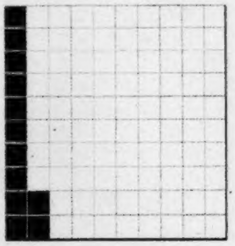
PLEASE NOTE: Research has shown that how people vote on a survey is often not a reliable indication of how people would actually vote at the polls. In surveys, some people ignore the monetary and other sacrifices they would really have to make if their vote won a majority and became law. We call this hypothetical bias. In surveys that ask people if they would pay more for certain services, research has found that people may say that they would pay 50% more than they actually will in real transactions.

It is very important that you "vote" as if this were a real vote. You need to imagine that you actually have to dig into your household budget and pay the additional costs.

You will now vote 8 times

- Assume that the options on EACH SCREEN are the ONLY ones available
- Each time, please vote independently from the other votes - do not compare options on different screens

Q12. PLEASE TREAT EACH VOTE INDEPENDENT FROM THE OTHER VOTES. NO OTHER PROTECTED AREA EXPANSION IS BEING CONSIDERED.

Protected area targets ■ **Protected land** □ **Normal land**	**0.6% (630 km^2)** of the Mixedwood Plains protected 	**12% (12,600 km^2 approx.)** of the Mixedwood Plains protected 
Year when protected area target is reached	**Not applicable**	**2026**
Your household's share of the annual investment paid through increases in taxes for the next 5 years, 2007-2011	**$0/Year for 5 years**	**$25/Year for 5 years**

Q13. Please carefully compare the two alternatives presented in the table above. If you had to vote on these two options, which one would you choose?

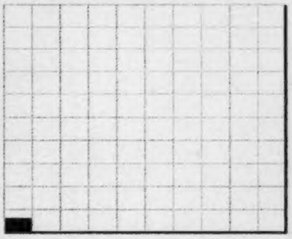
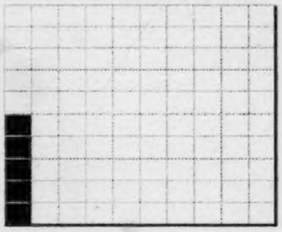
Please treat this vote independently from the previous vote. Please mark one box only.

Current situation ☐ **Proposed expansion** ☐

Q14. How certain are you that this is the choice you would make if this was an actual referendum? *Circle one only.*

1. Very Certain 2. Somewhat Certain 3. Somewhat Uncertain 4.Very Uncertain

Q15. PLEASE TREAT EACH VOTE INDEPENDENT FROM THE OTHER VOTES. NO OTHER PROTECTED AREA EXPANSION IS BEING CONSIDERED

Protected **area targets** ■ **Protected land** ☐ **Normal land**	**0.6% (630 km^2)** of the Mixedwood Plains protected 	**5% (5,250 km^2 approx.)** of the Mixedwood Plains protected 
Year when protected area target is reached	**Not applicable**	**2026**
Your household's share of the annual investment paid through increases in taxes for the next 5 years, 2007-2011	**$0/Year for 5 years**	**$25/Year for 5 years**

Q16. Please carefully compare the two alternatives presented in the table above. If you had to vote on these two options, which one would you choose?

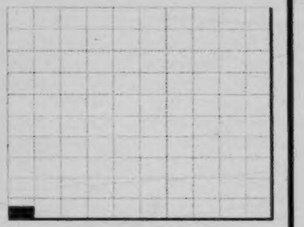
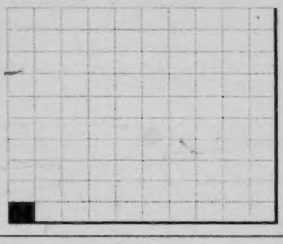
Please treat this vote independently from the previous vote. Please mark one box only.

Current situation	**Proposed expansion**
☐	☐

Q17. How certain are you that this is the choice you would make if this was an actual referendum? *Circle one only.*

1. Very Certain 2. Somewhat Certain 3. Somewhat Uncertain 4.Very Uncertain

Q18. PLEASE TREAT EACH VOTE INDEPENDENT FROM THE OTHER VOTES. NO OTHER PROTECTED AREA EXPANSION IS BEING CONSIDERED.

Protected area targets ■ **Protected land** ☐ **Normal land**	**0.6% (630 km^2)** of the Mixedwood Plains protected 	**1% (1,050 km^2 approx.)** of the Mixedwood Plains protected 
Year when protected area target is reached	**Not applicable**	**2016**
Your household's share of the annual investment paid through increases in taxes for the next 5 years, 2007-2011	**$0/Year for 5 years**	**$60/Year for 5 years**

Q19. Please carefully compare the two alternatives presented in the table above. If you had to vote on these two options, which one would you choose?

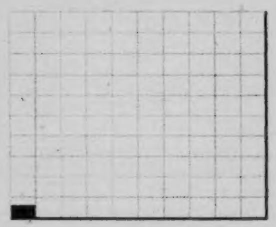
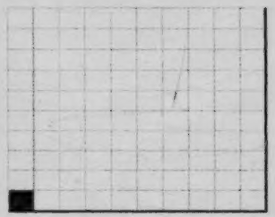
Please treat this vote independently from the previous vote. Please mark one box only.

Current situation ☐ **Proposed expansion** ☐

Q20. How certain are you that this is the choice you would make if this was an actual referendum? *Circle one only.*

1. Very Certain 2. Somewhat Certain 3. Somewhat Uncertain 4.Very Uncertain

Q21. PLEASE TREAT EACH VOTE INDEPENDENT FROM THE OTHER VOTES. NO OTHER PROTECTED AREA EXPANSION IS BEING CONSIDERED.

Protected area targets ■ **Protected land** □ **Normal land**	**0.6% (630 km^2)** of the Mixedwood Plains protected 	**1% (1,050 km^2 approx.)** of the Mixedwood Plains protected 
Year when protected area target is reached	**Not applicable**	**2016**
Your household's share of the annual investment paid through increases in taxes for the next 5 years, 2007-2011	**$0/Year for 5 years**	**$130/Year for 5 years**

Q22. Please carefully compare the two alternatives presented in the table above. If you had to vote on these two options, which one would you choose?

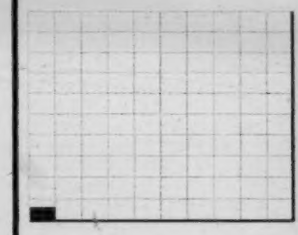
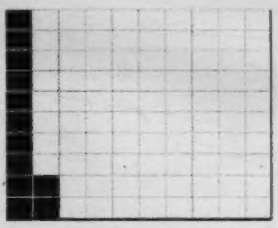
Please treat this vote independently from the previous vote. Please mark one box only.

Current situation ☐ **Proposed expansion** ☐

Q23. How certain are you that this is the choice you would make if this was an actual referendum? *Circle one only.*

1. Very Certain 2. Somewhat Certain 3. Somewhat Uncertain 4.Very Uncertain

Q24. PLEASE TREAT EACH VOTE INDEPENDENT FROM THE OTHER VOTES. NO OTHER PROTECTED AREA EXPANSION IS BEING CONSIDERED.

Protected area targets ■ **Protected land** ☐ **Normal land**	**0.6% ($630\ km^2$)** of the Mixedwood Plains protected 	**12% ($12{,}600\ km^2$ approx.)** of the Mixedwood Plains protected 
Year when protected area target is reached	Not applicable	**2016**
Your household's share of the annual investment paid through increases in taxes for the next 5 years, 2007-2011	**$0/Year for 5 years**	**$60/Year for 5 years**

Q25. Please carefully compare the two alternatives presented in the table above. If you had to vote on these two options, which one would you choose?

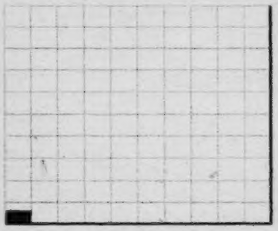
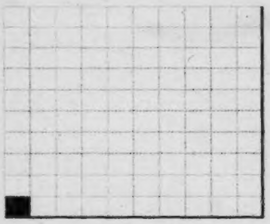
Please treat this vote independently from the previous vote. Please mark one box only.

Current situation ☐ **Proposed expansion** ☐

Q26. How certain are you that this is the choice you would make if this was an actual referendum? *Circle one only.*

1. Very Certain 2. Somewhat Certain 3. Somewhat Uncertain 4.Very Uncertain

Q27. PLEASE TREAT EACH VOTE INDEPENDENT FROM THE OTHER VOTES. NO OTHER PROTECTED AREA EXPANSION IS BEING CONSIDERED.

Protected area targets ■ **Protected land** □ **Normal land**	**0.6% (630 km^2)** of the Mixedwood Plains protected 	**1% (1,050 km^2 approx.)** of the Mixedwood Plains protected 
Year when protected area target is reached	Not applicable	**2026**
Your household's share of the annual investment paid through increases in taxes for the next 5 years, 2007-2011	**$0/Year for 5 years**	**$250/Year for 5 years**

Q28. Please carefully compare the two alternatives presented in the table above. If you had to vote on these two options, which one would you choose?

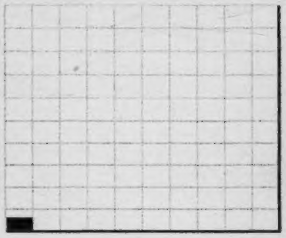
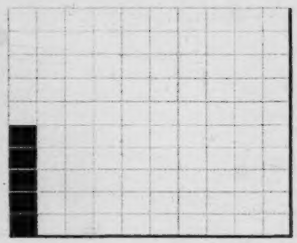
Please treat this vote independently from the previous vote. Please mark one box only.

Current situation ☐ **Proposed expansion** ☐

Q29. How certain are you that this is the choice you would make if this was an actual referendum? *Circle one only.*

1. Very Certain 2. Somewhat Certain 3. Somewhat Uncertain 4.Very Uncertain

Q30. PLEASE TREAT EACH VOTE INDEPENDENT FROM THE OTHER VOTES. NO OTHER PROTECTED AREA EXPANSION IS BEING CONSIDERED.

Protected area targets ■ **Protected land** ☐ **Normal land**	**0.6% (630 km²)** of the Mixedwood Plains protected 	**5% (5,250 km² approx.)** of the Mixedwood Plains protected 
Year when protected area target is reached	Not applicable	**2016**
Your household's share of the annual investment paid through increases in taxes for the next 5 years, 2007-2011	**$0/Year for 5 years**	**$130/Year for 5 years**

Q31. Please carefully compare the two alternatives presented in the table above. If you had to vote on these two options, which one would you choose?

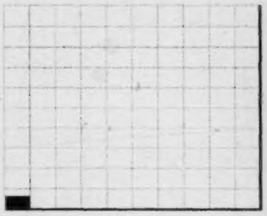
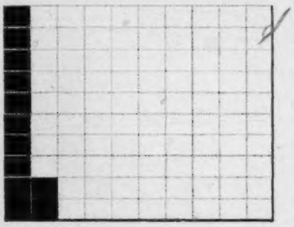
Please treat this vote independently from the previous vote. Please mark one box only.

Current situation ☐ **Proposed expansion** ☐

Q32. How certain are you that this is the choice you would make if this was an actual referendum? *Circle one only.*

1. Very Certain 2. Somewhat Certain 3. Somewhat Uncertain 4.Very Uncertain

Q33. PLEASE TREAT EACH VOTE INDEPENDENT FROM THE OTHER VOTES. NO OTHER PROTECTED AREA EXPANSION IS BEING CONSIDERED.

Protected area targets ■ **Protected land** □ **Normal land**	**0.6% (630 km^2)** of the Mixedwood Plains protected 	**12% (12,600 km^2 approx.)** of the Mixedwood Plains protected 
Year when protected area target is reached	Not applicable	**2026**
Your household's share of the annual investment paid through increases in taxes for the next 5 years, 2007-2011	**$0/Year for 5 years**	**$250/Year for 5 years**

Q34. Please carefully compare the two alternatives presented in the table above. If you had to vote on these two options, which one would you choose?

Please treat this vote independently from the previous vote. Please mark one box only.

Current situation ☐ **Proposed expansion** ☐

Q35. How certain are you that this is the choice you would make if this was an actual referendum? *Circle one only.*

1. Very Certain 2. Somewhat Certain 3. Somewhat Uncertain 4.Very Uncertain

Please answer the following questions to help us determine why you voted the way you did.

Q36. When making your choices in the eight votes, how important was each of the following to you? *Mark the box* ☒ *of your answer for each item.*

	Not important at all ▼	Slightly important ▼	Very important ▼	Extremely important ▼
Size of the protected area expansion	1 ☐	2 ☐	4 ☐	5 ☐
Year when the protected area target was reached	1 ☐	2 ☐	4 ☐	5 ☐
Additional annual cost to your household in provincial income taxes	1 ☐	2 ☐	4 ☐	5 ☐

Q37. If I voted to keep the current situation it was because:

In the first column, please check all reasons that apply. In the second column, of those selected, please check THE MOST IMPORTANT REASON by marking one box only.

4 1	**Please check all that apply**	**Of those selected, please check the most important reason**
I do not believe the program will actually generate improvements in the natural environment	☐	☐
I think our tax money could be better spent on other issues	☐	☐
I do not have enough information to make this decision	☐	☐
I felt the protected area targets were reached too late	☐	☐
I felt the protected area targets were reached too soon	☐	☐
I thought the total size of the proposed protected area expansion was too small	☐	☐
I thought the total size of the proposed protected area expansion was too large	☐	☐
The price was too high	☐	☐

Q38. If I voted for the proposed program it was because:

In the first column, please check all reasons that apply. In the second column, of those selected, please check THE MOST IMPORTANT REASON by marking one box only.

	Please check all that apply	**Of those selected, please check the most important reason**
I think this is a small amount to pay for the benefits received	☐	☐
I believe that we should protect the natural environment regardless of the cost	☐	☐
I feel it is the 'right' thing to do	☐	☐
It is important to invest in protecting these ecosystems for future generations	☐	☐
The program is important but I don't really think that the program will cost me directly	☐	☐
I might visit these protected areas in the future	☐	☐

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Q39. Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you STRONGLY AGREE, MILDLY AGREE, are UNSURE, MILDLY DISAGREE, or STRONGLY DISAGREE with it.

POSSIBLE CONCERNS	STRONGLY AGREE	MILDLY AGREE	UNSURE	MILDLY DISAGREE	STRONGLY DISAGREE
1. We are approaching the limit of the number of people the earth can support	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
2. Humans have the right to modify the natural environment to suit their needs	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
3. When humans interfere with nature it often produces disastrous consequences.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
4. Human ingenuity will insure that we do NOT make the earth unlivable	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
5. Humans are severely abusing the environment	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
6. The earth has plenty of natural resources if we just learn how to develop them	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
7. Plants and animals have as much right as humans to exist	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
9. Despite our special abilities humans are still subject to the laws of nature	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
11. The earth is like a spaceship with very limited room and resources	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
12. Humans were meant to rule over the rest of nature	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
13. The balance of nature is very delicate and easily upset	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
14. Humans will eventually learn enough about how nature works to be able to control it	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
15. If things continue on their present course, we will soon experience a major ecological catastrophe	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q5. Are you a member of a conservation or environmental organization?

○ Yes
○ No

Thank you very much for you assistance and participation! We value your time and effort in completing the survey!

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